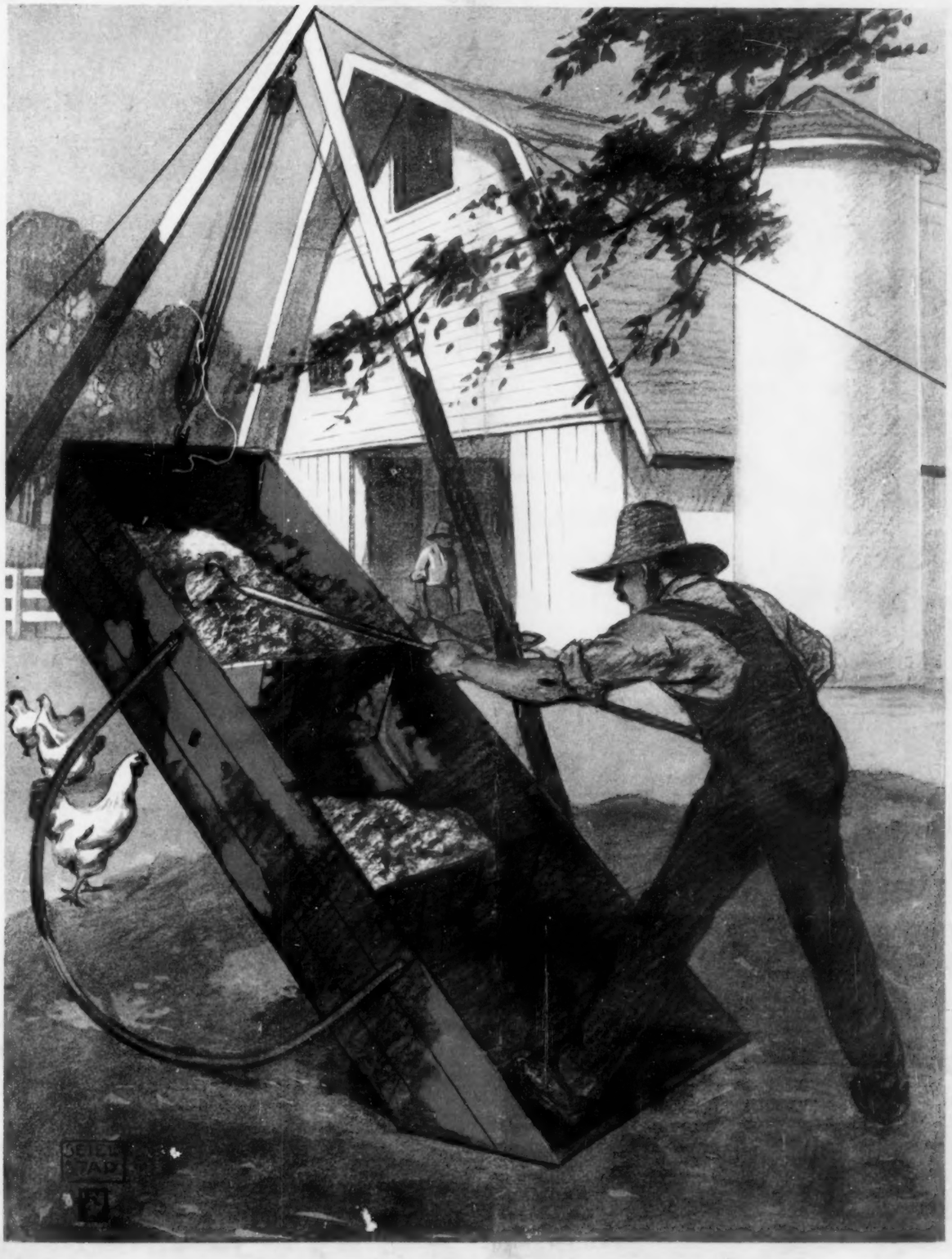
SCIENTIFIC AMERICAN

Entered as second class matter June 18, 1879, at the post office at New York, N. Y., under the Act of March 3, 1879.



THE SEE-SAW CONCRETE MIXER FOR THE SMALL JOB—[See page 279]

Vol. CXXI. No. 12
September 20, 1919

Published Weekly by
Scientific American Publishing Co.
Munn & Co., New York, N. Y.

Price 10 Cents
$5.00 a Year

HISTORY OF THE UNITED STATES
urlong
1½ MILES FROM HERE
Once the home of the Delaware Indians who made a treaty (1683) with William Penn that was respected long after his Death. The Six Nations at their Council fire in 1742 upheld the treaty.
HISTORY OF THE UNITED STATES
United States Tires
Are Good Tires
United States Tires
SALES & SERVICE DEPOT
LOOK FOR THIS SIGN

Road Signs that Point the Way

Hundreds of United States Tire Historical Bulletins have been erected at memorable spots on America's highways—many of them at requests of Chambers of Commerce, Boards of Trade and other municipal bodies.

These signs mark the way to places of unusual interest. They also point out clearly the short, straight road to tire satisfaction.

By sheer merit, 'Royal Cords' typify the uttermost in present day tire achievement.

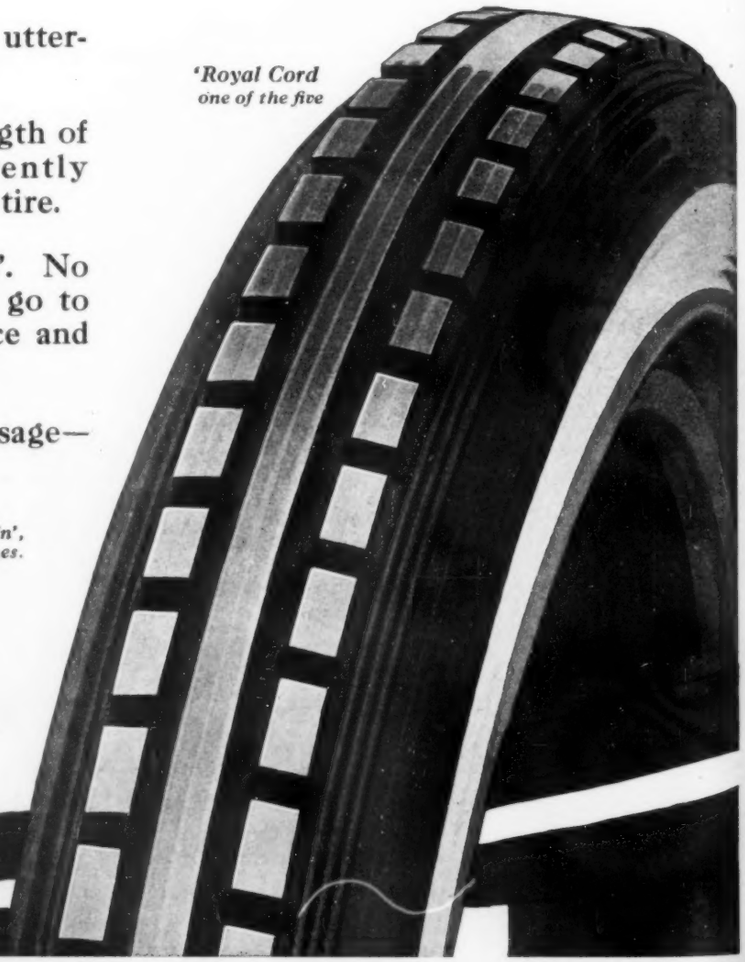
There is good reason for the super-strength of 'Royal Cords'. It comes from the inherently strong interior forces that are built into the tire.

No other tires are built like 'Royal Cords'. No other tires are made by methods which go to such lengths to ensure powers of resistance and endurance.

'Royal Cords' are built to give more usage—more mileage—more money's worth.

For passenger and light delivery cars—'Royal Cord', 'Nobby', 'Chain', 'Usco' and 'Plain'. Also tires for motor trucks, cycles and airplanes.

United States Tires are Good Tires



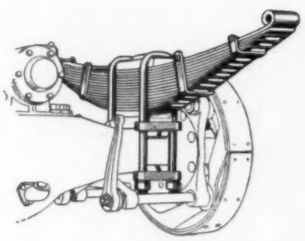
'Royal Cord one of the five

UNITED STATES RUBBER COMPANY
US
RUBBER SYSTEM
AND ASSOCIATED COMPANIES

GMC

General Motors Trucks

—In Marketing Livestock



The Springs

GMC Springs, as one unit in the structural plan, are wider, longer, and more sturdy, amply strong to carry the rated load under all road conditions. On the efficient functioning of these Springs, depend long life and flexibility.

This ton-and-a-half GMC Truck earned $3,300 the first year of its operation hauling livestock for its owner, A. C. French, Honey Creek, Ia.

In 250 trips from Honey Creek to the South Omaha stock yards a million pounds of cattle on the hoof were carried—a total mileage of 8,750 miles.

According to the owner's statement, taken from detailed daily records, the total upkeep expense for this first 12 months was $6.90, and the original tires are apparently good for another 12 months.

Still another profitable feature of the performance of this GMC Truck—and one, by the way which does not appear in the daily record—was the prevention of loss through shrinkage. That alone is a big item.

GMC Trucks are built with every regard for the efficient service shown in this instance—economy of operation, mechanical strength, reliability, endurance and low tire expense.

Behind every GMC Truck is the backing of the General Motors Corporation, the largest and most important organization in the automotive industry.

GENERAL MOTORS TRUCK CO

One of the Units of the General Motors Corporation

PONTIAC, MICHIGAN, U. S. A.

Branches and Distributors in Principal Cities

(535

"Buy Firestones"

That's the Word That's Going Round This Year

Wherever you go you hear car owners passing the word—"Buy Firestones. They're the best cords this year." The reasons are many, but the conclusion is the same—Buy Firestone Cords.

Read these spoken advertisements for the New Standard Oversize Firestone Cord with Extra Heavy Non-Skid Tread:

"It gives me a lot more service than the mere guarantee."

"Not only fine service but a tire that looks right."

"The extra air gives easier riding."

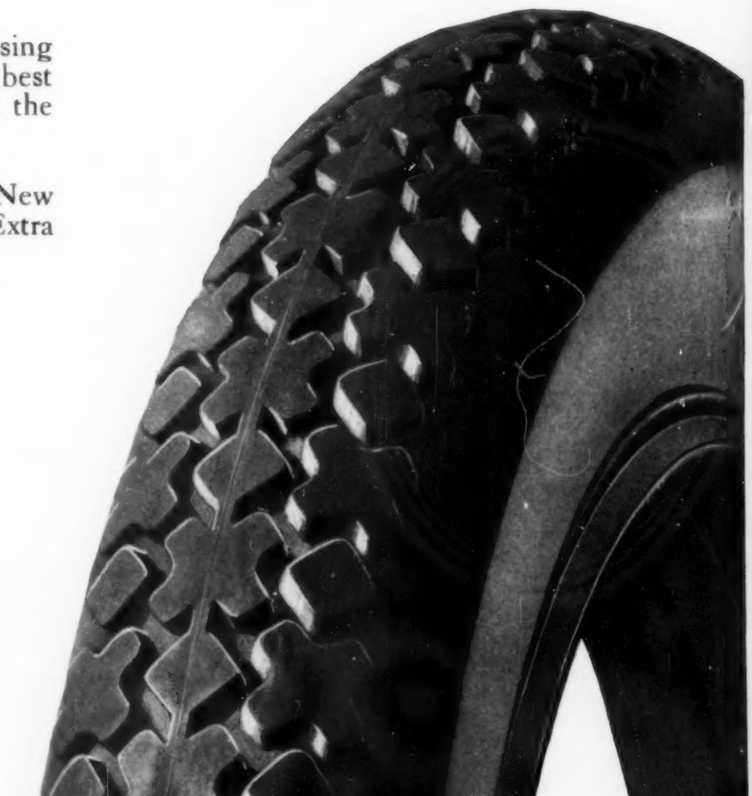
"The non-skid tread is fine; it holds in all kinds of roads and yet there's no power wasted."

"I bought it because of its extra size and the Firestone reputation."

"You'll notice that you go farther on a gallon of gas."

"It steers easy and grips the road."

With the mouth-to-mouth tire advertising centered on Firestone this year no thinking tire buyer can afford to remain uninfluenced. See your dealer.



Most Miles *per* Dollar

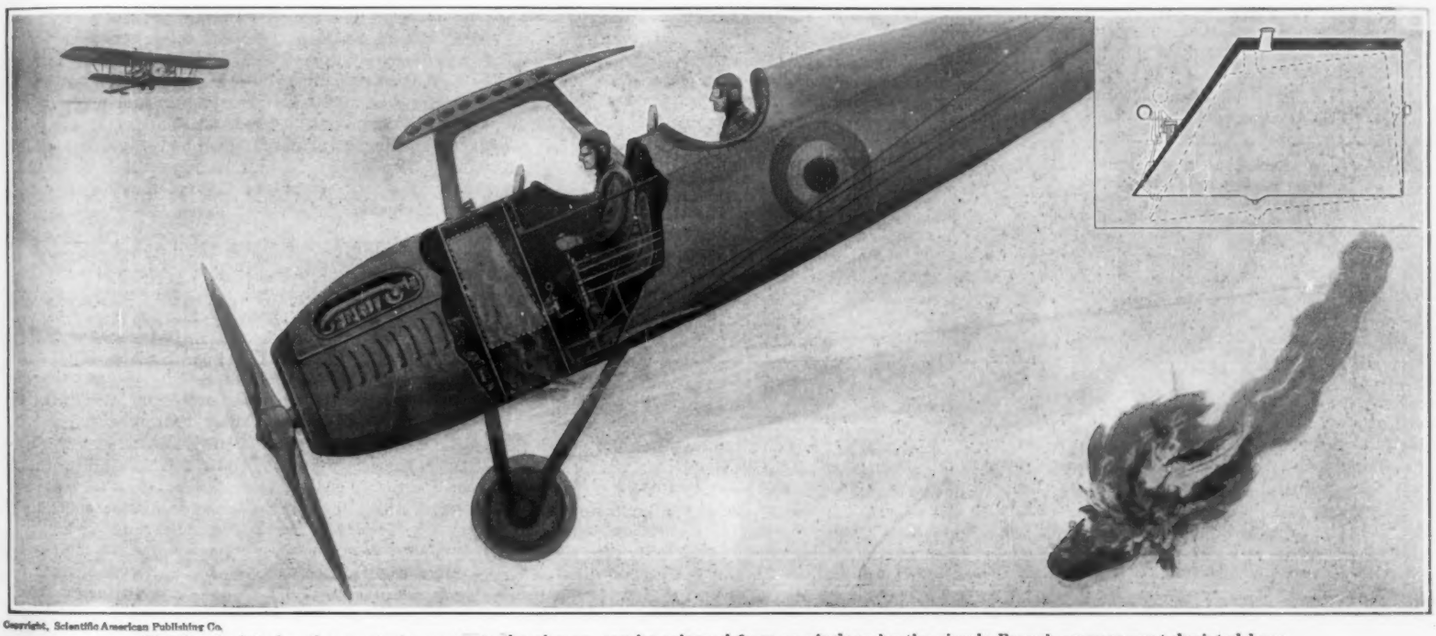
Firestone

SEVENTY-FIFTH YEAR

SCIENTIFIC AMERICAN

THE WEEKLY JOURNAL OF PRACTICAL INFORMATION

VOLUME CXXI.] NUMBER 12] NEW YORK, SEPTEMBER 20, 1919 [10 CENTS A COPY $5.00 A YEAR



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Flaming fuel tanks, the greatest menace to the airman, can be released from an airplane by the simple French arrangement depicted here

Reducing the Fire Hazard in the Airplane

FIRE is the greatest danger faced by the airman. Structural collapse, loss of control, collision, engine failure, bad landings—all these possibilities are serious, to be sure; but conflagration in mid-air is the one danger over which the airman has little control and still less chance of combatting, once it starts.

Various methods of reducing the fire hazard to a minimum have been worked out by British and French aircraft constructors, and many of the modern French airplanes are fitted with detachable or protected fuel tanks, or tanks arranged with rip patches. In the case of the French airplanes, too, great care is taken with the gasoline, oil, and water installations, in order to ensure that installation failures should not provoke disasters. All air intakes have to be carried outside the engine fairing and so arranged that communication with the interior of the cowling is impossible, so that the risk from back fires is reduced to a minimum. Pressure fed gasoline delivery is forbidden. Ignition wires must pass under and not over the gasoline pipes.

The obvious thing to do with a flaming fuel tank is to drop it overboard. And so the problem of designing and constructing a fuel tank that could be instantly detached and released from an airplane at the will of the pilot has not failed to receive considerable attention. First in England, and later in France, actual tests have been carried out with encouraging results.

Various schemes have been worked out for detachable fuel tanks. Some depend on releasing a carriage which carries the tank, while others depend on the tripping of a latch. One of the French schemes for a detachable fuel tank is depicted in the accompanying illustration. The tank, in this case, is sort of wedge-shaped, and held in a wedge-shaped compartment by means of a simple latch device. The latch can be released from the cockpit, and the same operation shears all the pipe connections. Gasoline pipes coming from the gravity tank are previously closed off by a pet cock, or else automatically prevented from wasting fuel by a ball check valve.

As might well be expected, there are numerous objections to such an installation. The machine must be rearranged in most instances, resulting in some weaknesses. The fuel system must be altered, perhaps with detrimental results. The pilot is apt to release his tank without cause, due to nerves, resulting probably in a forced landing. In some cases, particularly the French Breguet bombers, tanks have become loose due to vibration. In a crash the detachable tank is just as likely to take fire as an ordinary tank. All in all, however, the detachable tank represents a distinct step forward in airplane design.

Then there are numerous schemes for protected tanks. The idea of covering a gasoline tank with India rubber originated with an Englishman, who took out a patent as far back as 1909. Various improvements have since been suggested, and a tank has finally been evolved which will take 20 or more incendiary bullets without leaking, and will not take fire even in a bad crash. One French inventor has developed a tank built of light steel with outer and inner walls, the intervening space being filled with glycerine and gelatine composition apparently similar to that which was at one time used as a filler for what were considered puncture-proof tires. The composition is supposed to close and fill any hole made in this tank. However, the weight is so excessive that the tank has received little consideration.

Two French inventors have worked out a scheme calling for a steel tank of ordinary construction covered by a layer of felt and six or more layers of sheet rubber. One or more of the rubber sheets are separated by coarse interlaced hemp cord, and the whole construction is bound in place by a galvanized wire netting. This tank has been provided with a funnel member at the bottom which gathers such fuel as escapes from the tank and percolates down through the layers of the cover. Tests have shown that this tank is fairly satisfactory, although its great weight is against it.

In the machines constructed in France for the United States Air Service, non-inflammable tanks were installed and at least one type of machine, namely, the Sopwith "Dolphin," was arranged for the non-pressure system. These tanks may be described as a semi-rigid type. Essentially, each tank consists of an inner metal shell of medium thickness, covered with fabric and layers of vulcanized rubber of varying degrees of elasticity and outer layers of fabric and a screen covering.

Practically all of the fireproof tanks in existence are based on the use of several layers of rubber or fabric in combination with metal. The idea is to afford a flexible construction which closes in after being perforated, and which can withstand severe shocks without breaking apart. Originally, the fireproof tank was intended wholly for fighting machines, and it is certain that if the war had continued till this year, both sides would have employed fireproof machines. As it is, the fireproof tank, both of the detachable and non-leaking types, has a decided peace application if airplanes are to be made safe.

American Iron in British Steel

CONDITIONS at Sheffield and other tool centers of England became decidedly serious following the submarine blockade which effectively shut off the supply of Swedish iron commonly used as the base of high carbon tool steel. Yet England had to have tools and there was an immediate scurring about to find a substitute.

Because of its close proximity in purity to Swedish iron one of the first metals the English metallurgist turned to in this time of need was an American iron already being manufactured in England under license. It had often been suggested as a satisfactory substitute for Swedish iron because of its purity and uniformity. The result of the investigation was the final use of this iron with entire satisfaction, and the entire tool production of England during the last year of the war was practically dependent upon it.

SCIENTIFIC AMERICAN

Published by Scientific American Publishing Co.

Founded 1845

New York, Saturday, September 20, 1919

Munn & Co., 233 Broadway, New York

Charles Allen Munn, President; Orson D. Munn, Treasurer
Allan C. Hoffman, Secretary; all at 233 Broadway

Entered at the Post Office of New York, N. Y., as Second Class Matter
Trade Mark Registered in the United States Patent Office

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The object of this journal is to record accurately and lucidly the latest scientific, mechanical and industrial news of the day. As a weekly journal, it is in a position to announce interesting developments before they are published elsewhere.

The Editor is glad to have submitted to him timely articles suitable for these columns, especially when such articles are accompanied by photographs.

The Montauk Terminal Folly

IN the days of our fathers and grand-fathers, when passenger travel by sea was sheer discomfort, any scheme that would shorten the passage was welcomed. Hence the proposal to build a steamship terminal at Montauk Point, the extreme easterly point of Long Island, and make it the port of arrival and sailing for European steamers, made a strong appeal. For we must remember that the proposal was made in an era when the transatlantic steamer, compared with a modern "Leviathan" or an "Aquitania," was a small, slow and uncomfortable ship. When head seas were encountered she had to slow down, and against a full gale she made practically no headway. Freeboard was low, and the promenade decks were swept by green seas. In a stormy passage passengers would be held below decks in staterooms and saloons whose ventilation was unbelievably bad. Even when the passage was made under clear skies and with favoring winds the speed was slow. Today we may travel in 23-knot "Leviathans" and 25-knot "Mauritanias," in the days when Austin Corbin made his Montauk proposal, fifteen to sixteen knots was a fair average transatlantic speed.

Its first promoter failed to get anything done at Montauk, and as the years passed, and steamships grew in speed, weatherliness and comfort, the dream of a great ocean terminal on the easterly tip of Long Island faded away and passed into the realm of things that might have been.

But, recently, the Shipping Board has revived the idea in connection with the two thirty-knot 1,000-foot vessels, which it proposes to build and place upon the transatlantic route. So far as the two ships themselves are concerned, the proposal is sound; as regards making Montauk and not New York the port of call, it is foolish. We are able to build 1,000-foot ships, for the "Leviathan" is only 50 feet short of that length. They can be run at thirty knots, provided the traveling public is willing to foot the fuel bills by submitting to a great increase in the fares. But the proposal to dock them 120 miles from New York, among the sand hills of Montauk Point has not a single plea in its favor that will bear examination.

The object of landing at Montauk is to gain time at the sacrifice of comfort; for no one, we take it, will claim that travel in the relatively cramped accommodations of a train is so comfortable as travel by a luxurious ocean liner. And how much time would be gained by the transfer? Just about one hour and a half, as shown by the following comparison:

By the Montauk route at least half an hour would be lost in slowing down to take on the pilot and making the harbor and pier under a slow bell. The distance to the 33rd Street Pennsylvania Station is 117 miles and an average speed of 45 miles per hour would consume 2½ hours, making a total of 3 hours.

By the present route the distance from Montauk to Sandy Hook would be covered by a 30-knot ship in 3 hours, and it would take the vessel 1½ hours to reach her pier on the Manhattan water-front. The total time from Montauk to the Hudson River would thus be 4½ hours. The difference of an hour and a half would represent the possible gain in time due to a Montauk landing. For this slight advantage the passenger would have to submit to the inconvenience of a transfer from ship to train, when he might proceed on the ship undisturbed, to be landed in the heart of the city.

If the time ever comes when the public demands a shortening of the water distance to and from Europe, by an amount that will be really worth consideration, the ports selected will be either Boston or Halifax. Any reduction of time in sea travel less than would be gained by using these ports would not be worth consideration. Furthermore, would not the great sum of money necessary to construct a terminal at Montauk —a remote and undeveloped spot—be applied to much greater advantage in the improvement of the existing harbor facilities at Boston, New York and Philadelphia?

Metal Airplanes

DURING the autumn of 1910, when the great airplane meet was being held on Long Island, we published an article, dated October 22nd, entitled "A Study of the Racing Aeroplane of the Future." The object of the writer was to foretell the probable lines of development which would be followed in the effort to increase the strength, speed, and reliability of the future racing machine. It was predicted that, since nature is the great master builder, the future development of the airplane, in several important respects and particularly in the matter of form, would tend to follow the fastest of the flying birds. "The future high-speed flyer will possess the same tapering, rounded body and the wide-spread wings of narrow width, which characterize the swiftest of the birds."

But it is not so much the question of form as that of materials of construction that we wish to discuss just now. Speaking of materials, the article goes on to say, "The present wood-canvas-and-wire construction will have to go. It is makeshift work at the best, and was adopted because, in the early days of experiment, it offered a cheap and light combination of material, and one which, in the event of inevitable breakages incidental to experimental work, could be cheaply repaired. Its place will be taken by some one of the many remarkable alloys of steel which are now available—metals of enormous strength and toughness in proportion to their weight. The use of these, coupled with careful designing by the skilled engineer, will make it possible to produce an aeroplane of much greater strength, that will weigh no more than the present machine, and will present far less resistance to the air."

At the present writing there are many indications that this prediction of the substitution of metal for wood, will take place, more than one of the leading manufacturers having built, or being now engaged in building, machines, the framework of which is entirely of metal. We were wrong, possibly, in selecting steel as the material; for it seems that the best results are being obtained with aluminum alloys and notably with duralumin which, it appears, is showing a saving in weight of 20 to 25 per cent as compared with corresponding members built in spruce.

Some extremely interesting facts have been made public by the firm which built the Vickers-Vimy bombing machine that made the sensational flight from America to Europe in sixteen hours. The attention of Messrs. Vickers was drawn to the question of finding a satisfactory substitute for spruce, when it became evident during the war that there was impending a serious shortage of timber. They were requested in August, 1918, to consider the matter of metal construction and particularly, to investigate the possibilities of building the frame-work of the wings in metal. Fortunately, they had already done much experimental work in connection with light girders for rigid airships, which was turned to useful account in the investigation.

Two metals presented themselves as being presumably most suitable, namely, high-tensile steel and duralumin. Because of the necessity for giving heat treatment after rolling, it was found to be impossible to produce thin sections of steel, straight and free from twist, and so the use of steel was temporarily abandoned, and it was decided to build duralumin spars until suitable steel could be produced. Some test spars were built for the Vimy bomber, and Handley-Page and Avro machines, and tests of full-sized spars of duralumin showed that strength for strength, there was a saving of 20 to 25 per cent in weight over spruce.

Loading tests of several complete wings made of duralumin showed that they can be made of equal strength to wings of spruce framing, for only 75 per cent of the weight. The Vickers firm is designing a seaplane of unusual size, the structure of which will be built entirely of the new metal. Its total lift will be 50 tons, and 20 tons of this will be available for fuel, oil, passengers and freight. The estimated speed is 100 miles per hour.

Apart from the remarkable saving in weight, too strong emphasis cannot be laid upon the greater reliability due to the substitution of this strong and very tough metal for wood. It matters not how careful be the selection and subsequent inspection, there is always a possibility of some hidden and undiscoverable flaw in members which are built of spruce. No doubt many airplane failures and fatalities, which have been charged to careless inspection, have been more the fault of nature than of the inspector and the mechanic.

Sound—A Unique Form of Energy

WHY unique? For this reason: Most forms of energy have some definite utility in man's industrial pursuits. Heat fires our boilers. Light illuminates our homes, factories and thoroughfares; it also raises our crops of cereals and other vegetable foods. Electricity conveys power from the central station to the place of consumption, whether for motive purposes, lighting, heating or what not. The energy of the waterfall drives turbines, which in their turn energize, by electric transmission, entire districts of industry.

But sound appears in industry almost exclusively as a useless and often burdensome, nerve-racking by-product. Every motor, every piece of machinery, every street car, in fact everything that moves creates its own disturbance and adds its share to the continual waste. Almost the only industrial use of sound is the signal of the whistle calling to work or sounding the hour of dismissal.

Yet, by a strange freak of circumstance, this same form of energy, otherwise so useless, comes to occupy a position of wholly unique and unparalleled importance in human affairs, through the fact that it is the normal and ordinary vehicle for the communication of thought between men, and for the dissemination of information at least by the primitive method of oral tradition. And in our very thoughts we make use of mental sound-pictures, words, reproductions in the memory of sounds previously heard.

The energy of sound thus stands in the closest relation to our psychology. The full significance of this will be understood only when science sheds light on the relation between mind and matter. But even in the present state of our knowledge, and on purely physical grounds alone the incalculable importance of sound as an influence upon the course of events can be clearly accounted for. The effects produced are wholly out of proportion with the energy expended, for we are dealing with a typical case of "trigger action." A touch of the finger upon the trigger of a gun sets free the irresistible energy pent up in the explosive charge. In the same way, a word of command starts a great ocean liner gliding down the ways—to select but one of innumerable mechanical illustrations that present themselves. But what illustration is needed? Who is so blind that he does not instantly perceive the stupendous power of sound as an agency shaping human affairs, and through them physical events? Let some cynic remark that speech forms no exception to other forms of sound, that it also is a waste form of energy. We shall not take him seriously, for we know that what distinguishes man from the brute, what more than anything else has given into his hand the rule over creation, is this strange use of sound energy, the marvelous gift of speech.

Electricity

A Timely Explanation.—With the coming of the winter months and short days most electric light companies are flooded with complaints from consumers. Electric current bills take a sudden jump in the fall, and continue to soar till January or February. With a view to meeting these complaints the Edison Company of Boston has installed a recording device for registering the light variation on various days, the idea being to present to consumers records of the amount of daylight at different times of the year, and in that manner account for the wide fluctuations in their bills.

New Electric Bulbs.—There has been recently introduced a new form of electric bulb which possesses marked advantages over the usual bulb in fixtures where no special shade or other protection is afforded for the eyes. The outstanding characteristic of this lamp is the pleasing softness of its light. The large volume of light which the small filament emits is diffused to the point where the bulb itself appears luminous. The white bulb—it is milky white in appearance—is made in the 50-watt size, and, notwithstanding the low brightness of the bulb, supplies more light than the 50-watt clear-glass bulb.

Electromagnetic Theory of the Telephone Receiver.—A comprehensive paper, by Dr. A. E. Kennelly and Mr. H. Nukiyama on the above subject has been read before the American Institute of Electrical Engineers during March last, and is now issued as a booklet by the Research Division of the Electrical Engineering Department of the Massachusetts Institute of Technology. The paper is mainly mathematical, and does not lend itself to abstraction, but it introduces some interesting modifications in the theory developed by the authors and others during recent years, taking into account the magnetomotive force produced by the vibration of the diaphragm in the permanent magnetic field. The motional power is derived partly from the testing alternating current and partly from changes in power expended in the magnetic circuit. The motional impedance circle, derived by the authors to explain the phenomena in the telephone receiver, may therefore also be regarded as a power circle, with components along three different axes of reference.

Conducting Aluminum—A New Invention.—A new invention called conducting aluminum M.277, which is said to be creating a profound impression, has been made by Dr. Georges Giulini, the most famous expert in the aluminum trade. This new metal is produced by putting the ordinary aluminum through a special patented process, by which it acquires the same mechanical qualities and capacities as bronze, copper, and brass without changing its specific weight. It is said that the price of the new metal can be kept within very low limits; so that, even at the prewar prices of other metals, it will be able, by reason of its smaller specific weight, to compete with copper and brass very favorably. The fact that the new metal is a conductor will make it especially in demand in the electrical trade. The inventor anticipates for it also a good market among the builders of motor cars, airplanes, ships, and railway carriages. Leading men to whom the invention is already known, are said to be much impressed with its possibilities.

Electrically-Heated Boilers.—A somewhat unusual problem is discussed in a recent issue of *Schweizerische Electrotechnische Zeitshrift*, namely, the use of electric heating for steam-raising boilers. The method would probably only apply in exceptional circumstances—for example, in cases where coal is scarce but water power is cheap. It appears that such conditions prevail in some wood pulp and paper factories of the Far North. Narrow tubes of insulating material containing water are vertically arranged so as to communicate with the interior of the boiler at the upper and lower ends of the tubes. Current is passed through the water columns enclosed in the tubes. The resistance is relatively high, and accordingly, high voltage alternating current is desirable, three phases being used. The current is regulated by moving the electrodes in the tubes. The efficiency of the boilers is said to exceed 95 per cent. One unit produces about 1.25 kg. of steam at 6 to 8 atmospheres. Electric steam boilers up to a capacity of 1,500 kw., with voltages of supply up to 10,000 volts, have so far been designed.

Astronomy

The Astronomical Society of the Pacific held a meeting on June 19th-21st at Pasadena in conjunction with the meeting of the Pacific Division of the American Association for the Advancement of Science, the sessions being held at Throop College.

Nova Persei appeared in 1901. According to a determination of its parallax by Prof. Turner, its distance is 350 light years. Hence the great catastrophe in faraway space which became visible to mankind in the year 1901 actually took place about 1551.

Temperature at the Center of the Sun.—In a paper in the *Comptes Rendus* A. Vronnet sets forth physical considerations supporting the belief that the temperature at the center of the sun, instead of being millions of degrees, as required by the formula for a perfect gas, cannot be much more than 10,000 deg. Cent.

Nova or Variable?—Prof. E. E. Barnard has described in the *Astronomical Journal* a star of unusual type, which appears to be either a variable of very long period and wide range of magnitude or an abnormal nova. The star does not appear on the Harvard plates from 1891 to 1908, nor on Wolf-Palisa charts of 1904 and 1905, with about 3 hours' exposure. Prof. Barnard first photographed it in 1909, when it was of the 13.9 magnitude, while on a plate which he took in 1915 it is of the 10.5 magnitude. It is also found on several Harvard plates since 1909.

Tycho Brahe's Observation Books.—The original records of Tycho Brahe's astronomical observations were sold long after his death to the King of Denmark and are now preserved at Copenhagen. A contemporary copy of most of them is at Vienna. This material is now being edited by J. L. E. Dreyer for publication at Copenhagen as volumes X to XIII of "Tychonis Brahe Dani Opera Omnia." Mr. Dreyer expects that his publication will serve to clear up some mistakes about the great astronomer and serve to show how important a part he played in the laying of the foundations of modern astronomy.

Belgian Astronomical Publications.—An interesting evidence of the industry and devotion of Belgian astronomers during the occupation of their country by the Germans is the recent appearance of the Annuaire de l'Observatoire Royal de Belgique for the years 1915, 1916, 1917 and 1918. The prefaces of the last three volumes are all dated Nov mber 11th, 1918, the day of the armistice. It appears that the books were printed in Brussels year by year without the knowledge of the Germans, but were not issued because they would have had to be submitted to the enemy censor. Much current information had to be omitted from the volumes later than 1916 for the reason that astronomical publications did not reach Belgium during the war. The work of the observatory was carried on during the war by M. Stroobant, chief astronomer, in the absence of M. Lecointe, who was an officer in the Belgian Army.

A New Method of Using Color Screens in observing the planets is described by Mr. F. G. Brown in the *Journal* of the British Astronomical Association. Mr. Brown places between the objective and the eyepiece of his telescope, about 6 inches from the eyepiece, a disk consisting of two semicircular pieces of tinted glass mounted in a short tube, with their diameters in contact. These halves are of contrasting colors—say orange and blue—and are set in such a way that their plane surfaces are not quite parallel. Two images are formed of the object viewed, one rich in orange and light, the other in blue. If the object is not in the center of the field, more light will be received by one screen than by the other. Thus the relative intensities of the two images may be varied at will by altering the position of the object in the field of view. The position in which images of equal intensity are formed will depend upon the color of the object. The double image is of much service in bringing out planetary detail. The appearance of Jupiter with such an instrument, says Mr. Brown, is of considerable interest, as well as of great beauty. "The two closely adjacent images are quite different in appearance apart from their color. The prominent feature in the blue image is the extreme darkness of the north equatorial belt. The south equatorial belt, on the other hand, is less conspicuous in the blue than in the orange image."

Industrial Efficiency

Tin-Plate Manufacture in Japan.—In Japan the demand for tin plate is continually increasing. The manufacture, however, cannot be pursued profitably in that country. Most of the imports come from the United States. In 1916 about 65,000 pounds were imported, but thereafter the annual shipments were reduced to 40,000 or 45,000 pounds, owing to the war. Since the proclamation of the armistice imports have been showing a slight decrease, and are not sufficient to satisfy the demand in Japan. It is reported, according to the *Japanese Chronicle*, that one of the big steel works has for some time past been carrying on experimental work in the manufacture of tin plate, and the results are so promising that commercial manufacture is soon to be started and the product put on the market.

Switzerland as an Experimental Market.—With the ending of the war and the gradual return to normal business conditions, the possibilities of Switzerland as an experimental field for introducing American products in the European market are of interest. In the future the American manufacturer who has once gained a place in the Swiss market will find it less difficult to extend his trade to Italy, France and central Europe. Selling methods that will appeal to the citizen of that part of Switzerland which borders on France will also appeal to the French citizen in about the same degree, and this will apply to other bordering countries. This is due to a similarity of language, ways, customs, and habits of thought between the different parts of Switzerland and the neighboring countries. Although the people are one and distinct in their fundamental ideas and aims in the details of their daily life and their manner of doing business, they greatly resemble the people of the respective bordering countries.

Effect of Alien Exodus from Canada.—Canadian manufacturers are beginning to realize what influence the steady stream of emigrants from Canada back to Europe will have on factory production. Ever since it became possible for these men to get boats home they have been leaving in hundreds. With business resuming normal conditions and factories trying to speed production to supply markets that are bare, the alien is becoming conspicuous by his absence. A large Canadian manufacturer has stated that he does not know how he is going to obtain unskilled labor. Scores of the men who have gone home to visit relatives, from whom they have not heard for five years, did all kinds of heavy jobs that Canadian workmen will not touch, no matter what wages are offered. The situation indicates that production may be greatly delayed and that orders are likely to remain unfilled because manufacturers will not have the unskilled help to get the work out as rapidly as usual. No branch of the industry will be hit harder, it is stated, than the metal trades, because of the large amount of heavy work involved.

"Selling in Foreign Markets," by Dr. Guy Edward Snider, of the College of the City of New York, has just been published by the Bureau of Foreign and Domestic Commerce. This is a collection of readings of some 600 pages, covering in a logical and coördinated manner various phases of marketing American products abroad. The new movement in education for foreign trade, the keynote of which is the unit short course dealing with some specific phase of the subject in a detailed and concrete manner, disclosed the fact that literature of a specific nature is lacking. There has been a great deal published for general reading in foreign trade, but little has been written specifically for college work. The Bureau of Foreign and Domestic Commerce, in coöperation with the Federal Board for Vocational Education, is extremely desirous of having introduced into evening schools and other educational institutions, including reading circles, a type of foreign trade study that will be more in the nature of a course in medicine than a course in hygiene, as has been the case in the past. That is, in order for a person to master sufficient details of the profession of exporting, a single course of reading, or a single volume, is insufficient just as a course in hygiene does not make one a physician. So the text of "Selling in Foreign Markets" is intended for the practical use of the future exporter.

Heaters for the orange groves, that burn coal, petroleum, coke or wood; and an effort made to overcome the frost by substituting an artificial covering in place of nature's canopy. But the "overhead" was too big

Jack Frost in the Orange Country

The Organization and Methods by Which California Growers Have Routed an Old Enemy

By John L. Von Blon

JACK FROST has met more than his match in the citrus-fruit growers of southern California. He does not often march upon their sunny country. Even more rarely do his attacks succeed. When freaky weather conditions make it possible for him to sneak down from the snow-decked mountain ranges he encounters defenses which are well nigh impregnable. The ranchmen, who are now gathering a crop of oranges and lemons that will bring them approximately $55,000,000, are so perfectly organized and equipped to combat the enemy that he cannot pass.

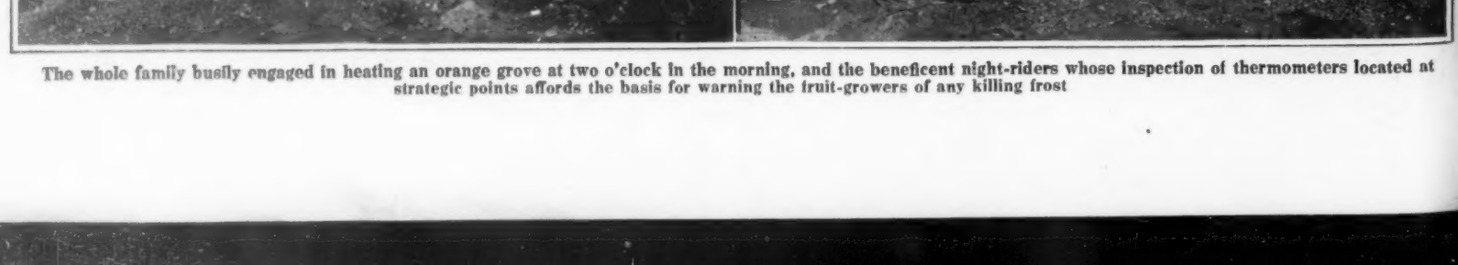
There are 25,000 of them and they have developed a system that savors of the military in its method, its thoroughness, its discipline and its guardedness. They have pursued a combination policy of steady preparedness and waiting watchfulness since their industry assumed great proportions, and they have demonstrated the soundness and wisdom of this course. They are abreast of the times. They are the only people in the world carrying frost insurance on so tremendous a scale. They used "gas"—the old-fashioned "smudge"—in their defensive warfare against the white nipper many years before gas was introduced on the battlefields of Europe.

Possibly some night next December, January or February, probably not for five years or ten years, severe frost may come. The growers will be found vigilant and ready, taking no chances. Orchard heating is their means of protection and they have reduced it to a science. It is practically universal throughout the citrus belt. There are 2,000,000 or more heaters in the southern California groves, nearly all "loaded" with two to five gallons of crude oil each and primed to be touched off at a moment's notice. They represent an investment estimated to exceed $2,000,000. Frequently it is argued, especially by tourists from the East, that in a region regarded as virtually frostless the growers are foolish to buy heaters at $1 apiece and place one beside every mature tree—seventy-five to a hundred per acre—but when it is remembered that good orchards frequently net their owners $1,000 an acre in a season it will be seen that the item is insignificant; and the ranchman feels much more comfortable in the knowledge of absolute security against the hour of emergency.

In every district the growers are banded in coöperative frost-protective associations, all conducted on practically the same plan. As illustrative of the smooth and effective workings of these organizations we will here consider the district which centers in Pomona. It covers a wide range of territory, includes three cities, and serves a citrus area of 4,000 acres. There are many smaller and perhaps a few larger but it is representative and a good example.

This district embraces thirty-five square miles. The ranches average ten acres. Within its limits are about 500 available telephones. It is laid out in seven routes numbered, like hotel floors, from 100 up. Seven modern "night riders," some in stripped motor cars and others on motorcycles, cover these routes—on cold nights only, of course. There are 136 government-tested thermometers for them to watch. Some of the patrolmen have as high as twenty-one to visit and observe. The instruments are on trees and telephone poles in the coldest spots. Those places which feel a drop in temperature first have been determined by careful study and the indicators located there. Each rider covers about twelve miles and must make the rounds, record his readings on a card, and get back to headquarters every fifty minutes. He is checked up as closely as a watchman in a powder plant. Paul Revere, the original "night rider," crawled through the Middlesex villages like a snail as compared with the speed these frost-danger scouts must make on the long macadamized boulevards. The Ku Klux Klan horsemen couldn't keep them in sight.

At the association's central office is a map showing the location of each thermometer. With the figures constantly coming in this serves also as an accurate temperature chart. If a patrolman finds the mercury at any point on his route going exceedingly low or



The whole family busily engaged in heating an orange grove at two o'clock in the morning, and the beneficent night-riders whose inspection of thermometers located at strategic points affords the basis for warning the fruit-growers of any killing frost

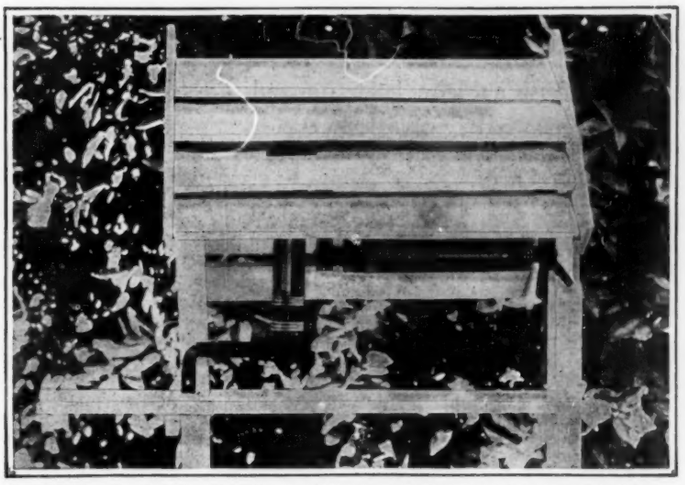
dropping abnormally he dashes to the nearest telephone and notifies headquarters so the alarm can be spread at once if deemed necessary. The patrols are on duty all night and whenever the headquarters thermometers register 34 degrees or below the riders are dispatched to the outposts because there is reason to suppose it to be colder in the orchards than in the city.

The 500 telephones are listed on seventeen sheets. Without regard to their location the numbers are compiled according to relative coldness. For instance those instruments in spots which become coldest quickly and most frequently are on the first sheet; and those of all lemon growers are likewise on a separate sheet because these are called first—at 27 degrees. The orange ranchers are rung up when the mercury falls to 26. Lemons are the more delicate. When the secretary of the association desires to give the alarm he rings "central" and directs her to call a specified sheet, the telephone company having duplicates of all. The association pays the wages of two extra operators on cold nights and gets quick action as the result of their exclusive services on first calls. In a little more than half an hour every grower in the district can be reached if he will answer the first call. If he doesn't respond and roll out after the second ring he is permitted to continue his pleasant dreams and it isn't the association's fault if his fruit suffers. There are men who would rather let a whole orchard freeze than leave a warm bed at 2 or 3 o'clock on a chilly morning.

When the ranchmen respond to call they hasten to their groves to light the heaters with long-stemmed oil cans containing gasoline which blazes from the spout. If the danger be grave entire families may get busy at this. If the temperature has risen perceptibly they do not apply the torch. Generally the lighters tie handkerchiefs over their nostrils to avoid inhaling fumes and smoke from the oil. The aim is to fire up just enough to play safe. Before the protective system was perfected growers would go out late in the evening, sniff the biting air, become frightened, burn valuable fuel all night and incur heavy unnecessary expense. Now there is no such waste. Ordinarily but a few acres in hundreds or thousands have to be heated, and seldom is a block of 400 acres or more lighted at the same time. The burners are unlikely to be kept going longer than half an hour, or at most an hour. They are extinguished by simply closing the drafts.

Heaters are more numerously placed along the outside rows of groves as a rule and in many instances lighted there only to hold the cold air out. Many growers rise early on cold mornings and light their border rows of heaters to raise a little oil fog bank and shelter the foliage of the trees from the bright sunshine after day breaks. The coldest hour is just before dawn. Frost does not spread broadcast. It picks out small landing places. It shows some of the characteristics of lightning but it can be determined almost to a certainty where it will strike. Nothing is more

Mixing concrete in the see-saw mixer



The latest type of self-registering moisture-proof thermometer, suspended in an orange orchard, yet so that free circulation of air to it will insure its giving the correct temperature. When it goes below 26 degrees the alarm is spread

pleasing in the citrus belt than night breezes. These are likely to scatter the layers of cold air, start them rolling and eliminate the danger of concentration and freezing in one spot.

Crude oil is the fuel now commonly used. It is stored in convenient tanks holding several thousand gallons, and the members buy it from the association. Sometimes the farmers put up their tanks individually, but more often coöperatively. At the close of each harvesting season the cost of protection, such as patrolling, office upkeep and many other items, is summed up on the pro rata basis, and each grower assessed according to the number of gallons of oil he purchased. The orchardist who consumes the most oil presumably gets the greatest benefit and bears the corresponding share of the outlay. This amounts in some years to an assessment of two mills per gallon and may sometimes go to three mills. When the cost of installation of apparatus has been offset protection is extremely small. On a ten-acre ranch it may range from $50 or less to $250 a year, dependent upon the weather. Many schemes have been evolved and tried to obviate this expenditure but none has proved successful. On a ranch near Redlands the owner essayed to battle off frost by stretching tobacco cloth over his acreage. The cloth was so placed that he could handle it much after the manner of a photographer drawing the curtains of his skylight to and fro. An amazing tented effect was produced and it attracted wide notice locally and in newspapers and magazines throughout the country. The frost was easily kept aloof but the "overhead" was prohibitive. The wind ripped the covering and there were other troubles, so the despised heating pots finally displaced it.

The idea of heating is to create a layer of warm air which shall rise treetop high and remain there as long as the burners are going. The original theory that a layer of dense smoke was efficacious or necessary has long since been exploded. In fact one principal aim now is to eliminate the smoke. "Smudging," with its gloomy black carbon pall, has proved such a nuisance to the public and as well to the growers, for it cost them a lot to have the sooty fruit washed, that every effort has been and is being made to keep the atmosphere clear and clean. Manufacturers of heaters have progressed of late years but their output is still far from perfection. An early morning street scene in a southern California city, after several hours of orchard heating the night before, is gloomy enough. The suspended carbon hangs low about the second story windows, and it is impossible to see at all at a distance of more than two or three blocks, while at much closer range things are cloudy and obscured. And this is saying nothing of the dirtying effect. The man who invents a smokeless burner of reasonable cost will not only be doing a service to the world, but his fortune will be assured. Here is an opportunity for some genius to make himself independently rich.

Heating is still called "smudging" and the necessary evil increases as the citrus industry expands. In some southern California communities it has become a vital issue. In Pomona, for instance, it is the principal question to be determined at the forthcoming spring election. In the corporate limits of that city are fully 800 acres of high-grade orange groves, and low-lying, so that the cold air drains in and creates frost by absorbing the moisture. These orchards are usually among the first to be warmed, and sometimes Pomona finds it difficult to get a peep at the morning sun through the smoke clouds. The past winter citizens started a fight against the smudge pots and the municipal authorities took it up. The Mayor, leading the anti-smoke forces, sought to have enacted an ordinance prohibiting smudging within the city. One councilman stood with him, two against, and the fourth declined to become involved, so no action resulted. Now it is to be decided by initiative; the Mayor, who is a candidate for re-election, fathers the proposition while the citrus men's candidate is supporting a much less drastic ordinance which, they contend, would sufficiently ameliorate conditions. There are nearly 6,000 registered voters, each with a decided opinion, and the unique contest is waxing warm. The outcome is looked upon as exceedingly important as a possible criterion for other communities.

The value of heating was never more completely brought out than during the early days of last January, when an unprecedented cold wave struck the citrus country. The damage was kept at a surprisingly low figure. The present crop, estimated at 50,000 carloads, establishes a record insofar as total returns to growers are concerned.

The See-Saw Concrete Mixer

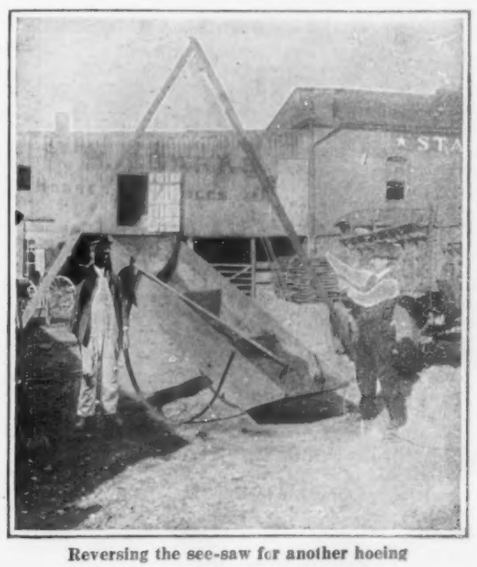
THERE are various ways of mixing concrete for the small job, and few of them are satisfactory beyond cavil. There can be no two opinions with regard to the unadvisability of giving up all hope of applying machinery to such work, and performing it wholly by hand. The dumping of cement, gravel, sand and water into a big wooden pan and the laborious hoeing of it into shape is hard work and slow work and above all is hardly likely to secure the best mixing. But it is not obvious just what direction the effort to improve on this procedure should take.

Perhaps the nearest approach to an actual adaptation of the regular concrete mixer to the small job is the barrel mixer which comes in a variety of makes and models. This does the work entirely by automatic methods, but the quantity of concrete which can be put in the barrel at one filling is not sufficient to guarantee the best results in uniformity of mixing; and it is only too true that the rolling action of the barrel fails properly to churn the mix, frequently rolling up pellets of dry cement.

Other schemes have been put forward which seek to compromise between the hoe and the full-sized mixer by requiring the operator to do some or all of the mixing himself, with a certain amount of mechanical aid. Of this type is the see-saw mixer invented by a Virginian farmer-machinist, and illustrated on this page and on our cover.

The inventor starts with the assumption that for the small batch of concrete there is no more satisfactory

(Continued on page 292)



Reversing the see-saw for another hoeing

High-Lights of Air-Travel

Some of the Things Seen from a Plane That Contradict Experience Gained on the Ground

By M. Luckiesh

PROGRESS in civilization is largely a conquest of Nature, and the Great War has taken us well into one of the greatest triumphs over Nature—the mastery of the air. Within the past few years thousands of persons have had aerial experiences which dwarf most of those of our two-dimensional world; and in the coming years mankind will come to view as commonplace scenes of the aerial world which heretofore have been visualized only in the imagination. There are many aspects of flying, from the superb thrills of the initial experiences to the placid consideration of the scenes which greet the veteran aerial passenger. If flying is to be fully enjoyed the aerial passenger must become interested in the scenes about him, thus not only adding interest to the trip but also providing occupation for his mind. This leaves little room for the suspense which is bound to attend flying for many years notwithstanding the relative safety of this activity as proved by statistics.

IN the coming years, mankind will view as commonplace the scenes of the aerial world which heretofore have been visualized only in imagination or by the pioneers of aviation. If flying is to be fully enjoyed, the aerial passenger must become interested in the scenes about him. What these will be the present article suggests.—THE EDITOR.

As one ascends he is impressed with the map-like appearance of the earth. The various patterns are also varied in color and in detail. When a high altitude is reached the earth apparently has flattened out into a wonderful detailed map. Country roads, sandy beaches, and other barren land are conspicuously bright amid their earthly surroundings, but closer observation leads us to the conclusion that the reflection factors of the various earth and water areas are in general low. The accompanying table of approximate reflection factors illustrates this point.

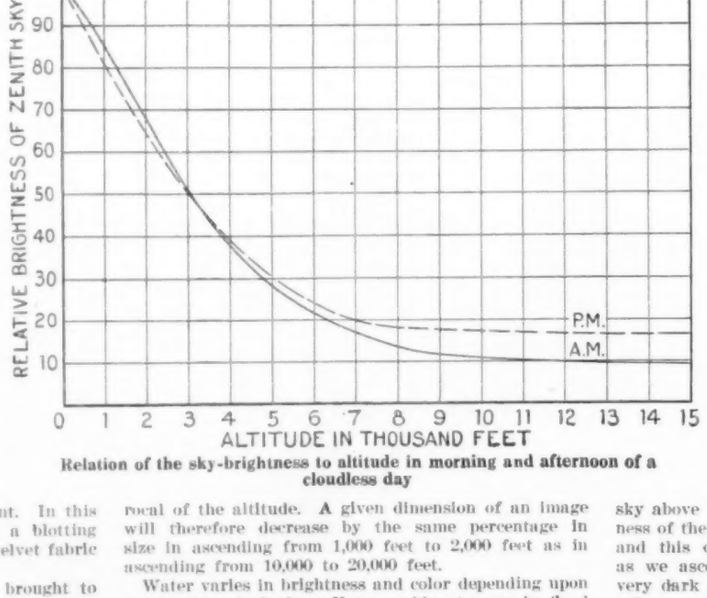
	Per cent.
Woods	3 to 5
Fields of grass and low-growing crops	5 to 10
Barren land (depending upon soil)	5 to 20
Inland water	5 to 10
Deep ocean water	3 to 5
Upper sunlit surface of dense clouds	70 to 80
Fresh deep snow	70 to 80
Perfectly white surface	100
Best white pigments	80 to 90
Black pigments	1 to 4
Black velvet	0.4

In order to visualize these values more satisfactorily let us imagine that we are to represent them by means of pigments. A perfectly white surface exists only theoretically. A good white pigment will represent snow but black velvet cannot be represented by a pigment. Therefore, suppose we arrange a scale with a piece of black velvet at one end and the best white pigment at the other. Black pigments would be placed next to the velvet and it is obvious that the earth areas (excepting snow) would be represented near the black end of the scale. They would be made by nearly submerging pigments of the proper hue with a black pigment. Although these low values are not generally noted without surprise, it is easy to account for them. Earth areas are not smooth; they possess depth. For example, a field of grass or of other crops possesses a texture somewhat similar to velvet but of greater depth, and, therefore, there are many light-traps and shadows intermingled with the high-lights. The result is a decreased brightness due to the admixture of dark shadows quite similar in effect to that of the admixture of black pigment with a green pigment. In this connection it is of interest to note that a blotting paper dyed with the same black dye as a velvet fabric will not be as black as the velvet.

Many other interesting points could be brought to light. For example, wet soil is darker than dry soil owing to the moisture which fills the interstices. The refractive index of water is greater than that of air, with the result that there is less light reflected at the surface of the particle of soil bounded by water than when air replaces the water. The experiment is easily performed with the blotting paper. Wet paper is darker than dry paper when viewed by reflected light, but the reverse is true when viewed by transmitted light. The brightness of barren land obviously varies greatly with the kind of soil but even for the same soil there is a considerable vairation, depending upon the character of the surface. A freshly plowed field even after it has dried is much darker than after it has become smoothed by many rains. This is another example of the effect of shadows and light-traps.

The colors of a landscape in summer are obviously those of vegetation, although to be exact, the bluish color of shadows receiving skylight on a sunny day must be taken into account. The colors of earth areas covered with vegetation are very dark shades varying in hue from yellow-green to blue-green. In late autumn the reflection factors remain about the same as in summer, the glory of the variegated leaves of the woods is soon lost as we ascend and the landscape becomes a variety of dull, dirty browns. The foregoing discussion accounts for the lack of "colorfulness" of the earth as seen from the air during any season. The colors are almost submerged with black and the glory of a variety of color such as autumn leaves or flowers is lost by blending when seen at a distance. Although one is somewhat disappointed in this respect, the dark shades and secondary colors are sufficiently effective to cause the passenger to alight from his first flight with a colored map of the earth as one of his vivid impressions.

Pattern is a striking feature of a landscape as seen from the air. On ascending one is conscious of the rapid decrease in the size of the patterns below him and after considerable experience it will become apparent that the patterns decrease much less rapidly in size at high altitudes than at low ones. The explanation is simple when considering the relation of the altitude to the size of an image made by a lens of constant focal length. Any given dimension of the visual image will vary approximately as the reciprocal of the altitude. A given dimension of an image will therefore decrease by the same percentage in size in ascending from 1,000 feet to 2,000 feet as in ascending from 10,000 to 20,000 feet.



Relation of the sky-brightness to altitude in morning and afternoon of a cloudless day

Water varies in brightness and color depending upon its depth and clarity. Very muddy streams in flood are exceptional cases and have the color and brightness of the soil. Ordinary inland waters such as rivers, large lakes and bays are usually a dirty yellowish green in color, with a mean reflection factor of seven per cent. Deep ocean water is a dark greenish blue and possesses a reflection factor of about three or four per cent. The brightness of water may be divided into two parts. One is due to the reflection of images of the sky and clouds and this component of brightness obviously depends upon the *brightness* of the objects themselves and upon the angle of incidence of the light. The other component is due to light diffused within the water due to suspended matter and bubbles, and it depends upon the *intensity of illumination*.

It is somewhat surprising that this is generally the predominant component. Shadows of clouds can be seen very conspicuously from the air and these verify the foregoing statement. In cross-country flying, clear, quiescent ponds of water are usually the darkest areas in the landscape. Often they appear like pools of ink and their relative brightness is much less than that of black velvet. This is easily explained. The water is perfectly clear and the bottom is black and porous. Little or no light is reflected except from the surface. Viewing a clear sky at perpendicular incidence, the brightness of the reflected image is only two per cent of the brightness of the sky. The sky contributes only a small part of the total light on a clear day and hence this two per cent of the brightness of the sky corresponds to but a fraction of one per cent of the brightness of a white surface receiving light from both the sun and sky. This accounts for the visibility of submerged objects such as fish, mines, and submarines, and even the bottom itself if the water is not too deep, when these are viewed vertically downward or nearly so.

Incidentally a pond of this type provides the best mirror in the landscape, for its background is almost perfectly dark, which is not the case for turbid water. If one watches very carefully he can detect the image of the airplane reflected in the water without difficulty at 2,000 or 3,000 feet. This gives a true vertical line which may be of use on some occasions. At least observation of this image gives a record of the horizontal speed regardless of the other movements of the airplane.

The earth haze is responsible for many beautiful effects in cloudland. It varies in density from day to day, and also in depth. Apparently it consists of dust and smoke; and the altitude of the upper surface appears to vary from 4,000 to 10,000 feet, according to the height of the diurnal air currents. Cumulus clouds are often seen rearing their heads out of the haze like submerged icebergs, and the top of this haze provides a horizon for the flyer above it. Clouds appear yellowish by contrast with this bluish or purplish haze and the clouds floating in this tinted luminous ocean provide one of the beautiful effects of the aerial world. Sometimes there is an upper haze apparently of vaporous clouds but so thinly diffused and uniform that no cloud shapes are visible. Both of these hazes are chiefly responsible for the brightness of the sky, although the earth haze contributes the predominant portion of the sky brightness as seen from the earth's surface. If there were no particles in the atmosphere to be illuminated, that is to diffuse light, the sky would be black or nearly so in the daytime and stars would be visible. On cloudless days the sky contributes usually from fifteen to twenty per cent of the total light reaching the earth at midday. On an average day the sky decreases rapidly in brightness as one ascends and it is not uncommon to see the haze horizon very distinctly at an altitude of about a mile. When there is but little of the upper vapor haze, the sky above the earth haze is a dark blue. The harshness of the sunlight is noticeable. Shadows are darker and this condition becomes gradually more striking as we ascend. At 20,000 feet the sky is sometimes very dark and measurements have shown that it contributes at this altitude as little as four per cent of the total illumination on a horizontal surface at midday. This variation of sky brightness is illustrated by the two curves plotted from data obtained in the morning and in the afternoon on the same day. The points where the curves flatten out indicate the top of the earth haze.

Of course the haze reduces visibility, but it does not add much to the earth's brightness as seen from above because it reduces the earth's brightness by absorption

(Continued on page 292)

Correspondence

The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.

The Metric Question—Both Sides

To the Editor of the SCIENTIFIC AMERICAN:

I have read with much interest the articles on the metric system by Messrs. Holst, Stewart and Kapeto in your impression for August 30.

Taking up, first, the letter of Mr. Holst, I can imagine nothing more useless in the affairs of everyday life than the fact that a liter of water weighs a kilogram. In the one field in which it might be of some use—naval architecture—it fails because of the increased gravity of sea water.

It is not as well known as it should be that the assumed relationships of the metric units are only approximate. As Dr. J. W. Redway has put it: "The meter is assumed to be the ten-millionth part of the earth's quadrant; but it is not. It is likewise assumed that the earth is an oblate spheroid, but it is not. It is assumed that the standard meter rod exactly represents the calculated meter, but it does not. It is assumed that the kilogram is the exact weight of a cubic decimeter of water under given conditions, but it is not. The liter is assumed to be a cubic decimeter, but it is not. Not one base unit of this 'scientific' system conforms to definition."

Mr. Stewart may dismiss his fears regarding the decimalization of the inch. Here and there someone can be found who favors it, but it is not the program of the organized opposition to the metric system. The substitution of decimal for binary divisions of the inch would destroy existing standards as completely as the adoption of the metric system. Moreover, we regard the binary as intrinsically superior to decimal divisions for constructive purposes. Mr. Kapeto has explained this so well that I do not need to repeat it. Binary divisions are, in fact, as physical things, one of the few perfect things in this world. Unfortunately, they are awkwardly expressed by decimal arithmetic, but that is the fault of the arithmetic and not of the sizes. Everybody knows that choice of 10 as a basis for notation was a matter of accident and most unfortunate. Had those ancient races which originated the decimal system omitted their thumbs when counting, the metric system would never have been heard of. If we are to do away with something, why does no one ever suggest that we do away with decimals and adopt a more convenient base of numeration?

It is gratifying to know that Mr. Stewart recognizes that "a certain loss to business men is unavoidable," but he fails to recognize the chief loss.

The couplings with which the hose ends of railway-car air brakes are connected were standardized, that is, made interchangeable, many years ago at the works of a leading manufacturing company. Because of that standardization, railway cars, both passenger and freight, when fitted with air brakes may be made up in trains regardless of the railroads of their origin and transported throughout our country. What would be thought of a man who would estimate the value of those standardized couplings in terms of the cost of the special tools and measuring instruments with which they are made? Is it not perfectly clear that their real value lies in the results which they accomplish, that is, the possibility of interchanging cars between railroads?

As another illustration, consider standardized pipe-fittings. Because those fittings are standardized, they are made by the million and may be bought at trifling cost in any pipe fitting shop. The piping of a building consists of little more than cutting pipe to length, threading its ends with standardized dies and assembling the resulting pipes with their connections and fittings. Consider the conditions that would obtain when piping a building for steam, water and gas were it necessary to make each fitting for its place and to order, and then ask yourselves what part of the real value of standardized pipe fittings is represented by the cost of the taps and dies with which the threads upon the pipe and fittings are made. Additional examples could be given without number, but these two should be sufficient to show that the value of these standards lies in the results which they accomplish and not in the tools with which they are produced.

We make laborious—almost infinite—efforts to standardize mechanical constructions, and when the work is done the standards work so smoothly and accomplish their objects so perfectly that we almost forget their existence. Because of this a few well meaning gentlemen deliberately propose that we abandon these standards, begin afresh and place ourselves exactly upon a level with metric countries which have no structural standards worth mentioning.

F. A. HALSEY.

New York.

To the Editor of the SCIENTIFIC AMERICAN:

The letter from Mr. M. Metlin of Chicago appearing in your issue of August 16th shows the advantages of metric weights and measures for the measurement of length. They, however, are found to be even more convenient than there indicated. Americans have not only used decimal currency but have used it in the most convenient way. We do not say, for instance, that a coat costs 2 eagles, 2 dollars, 7 dimes, and 5 cents, but we say that it costs $22.75. Metric weights and measures should be applied to each trade and industry in the most convenient manner, keeping the convenience of others in view.

Last year the writer asked a doctor in the Sloane Hospital the length of his son who had recently arrived there. The doctor turned to the record and said, "154 centimeters." The doctor went on to explain that there and at other hospitals in America physical measurements had always been made and recorded in centimeters. Among the advantages of using this measure are that no fractions are required and that it is understood and used throughout the world. This is an instance of international standardization on the right basis. Now as our object is to do work most effectively we only follow common sense and good practice when we use centimeters to measure people even after they have passed 100 centimeters in height. It is entirely unnecessary to introduce the decimal point here. When 100 cm. has been passed the person's height is, for instance, recorded as 105 cm., 154 cm., or 180 cm. The physical measurement of the students at Columbia University, for instance, is taken entirely in centimeters. If the new student is not familiar with centimeters, he is given a table of equivalents or told, for example, that 5 feet 8½ inches is equal to 174 cm.

H. RICHARDS, JR.

New York.

Visible Shells

To the Editor of the SCIENTIFIC AMERICAN:

Your Issue of August 2nd publishes a letter from Robert E. Womsley regarding visible shells in which he states that he never saw an enemy shell in flight nor anyone else who has.

I know of course that it was not a common experience to see shells in flight but I did hear of several cases while in France so that my own experience in that respect was not unique. It was while we were stationed in the Ypres salient on a bright clear day in August, 1916, that the following incident occurred. I was on duty in a bombing post several hundred yards in front of our lines. Fritz was shelling our front line some 200 yards in the rear with a battery of apparently 5.9 H. explosives. The whine of the shells of course could be distinctly heard and happening to look up I saw the shells passing overhead apparently at a height of about 20 feet I counted at least twenty shells passing before the battery quit firing and could see as many as three in the air at a time. They looked like long lead pencils with indistinct blurred edges.

Personally I am of the opinion that it would be impossible to see a shell in time to dodge it and the difficulty about hearing them is that although they may be heard distinctly enough a person could not judge the direction accurately within thirty yards or more.

G. H. CLARK.

Edmonton, Alberta.

A Forerunner of the Salvaging Submarine

To the Editor of the SCIENTIFIC AMERICAN:

Your article in the August 16th SCIENTIFIC AMERICAN entitled "A Salvaging Submarine" puts me in mind of a similar apparatus used for raising the Swedish steamer "Rhea," sunk in 197 feet of water outside Stockholm in 1896 or thereabout.

It was decided to lift the boat with pontoons and chains fastened in the portholes. To get the chain-hooks in the portholes, the depth being too great for divers, a 200-foot-long steel tube with a closed working chamber at the lower end was sunk in upright position alongside the vessel. The working chamber had a plate glass window and two arms or fingers on the outside which could be operated from the inside. The chain hook was guided into the porthole by means of these arms. When a sufficient number of chains were attached the vessel was lifted in the usual way.

As far as I know this is the first and only time such a tube was used and I also believe this is the greatest depth, 197 feet, from which a vessel was ever raised.

J. C. BJORKBOM.

Reading, Pa.

Some Blasting Technicalities

To the Editor of the SCIENTIFIC AMERICAN:

In an article on "Explosives" in the *Mining and Scientific Press* of Feb. 22, 1919, by Robt. S. Lewis, he says: "Fuse powder is a finely divided granulated 140 to 100 mesh black powder having potassium nitrate as an oxidizing agent. . . . A good black powder should be of even grain, of suitable hardness and density and free from dust; and ten grains flashed on a copper plate should leave no bead or residue."

In last week's SCIENTIFIC AMERICAN, giving an account of the first "shooting" of oil wells with black powder, it says: "and the force of the explosion is always up the hole, following the lines of least resistance."

With these facts confronting us, that in the explosive action of black powder, the bursting molecules of nitrogen gas escape up and out rather than down, we have a fundamental reason why misfired caps show burnt carbon on the cap surface, and that insufficient heat coming through the fuse, meets the compressed air always plugged into the cap by the close fitting fuse, and the instantaneous condensation of moisture results. Samples of fired caps will show extreme differentiation in the end spit of the fuse, and *any brand* of fuse tested by firing and holding the end of the fuse lightly on a smooth surface will show this woeful lack of natural precision.

The remedy for this state of affairs, in the present method of handling fuse and blasting caps, is in supplementing a pinch of fuse powder between the cap surface and fuse end.

Some one has said: "Any invention that tends toward eliminating the white man's burden, is a modern necessity."

The manufacturers of these supplies and others interested, can never get anywhere shifting the blame upon the user and the fuse.

The conclusion then, is this—that no one is to blame who has been careful with the best stock procurable, and still has misfires, and that such misfires occur:

1. By the explosive action of black powder following the lines of least resistance, and leaving too little powder at the point of contact—the cap surface.

2. Since the cap plugged in with the fuse does not constitute a vacuum, in the motion following the spitting fuse, there must necessarily be an equalization of the potential in atmospheric conditions. At such times when the fire in the fuse is not strong enough to overcome the air in the cap, the inevitable result is certain in the formation of carbon dioxide. Then, the unexploded cap is ready for its inefficient mission, if not worse.

Standardized safety fuse lengths supplied by the manufacturers show the logical way out. These lengths should come to the user in paraffined cardboard cylinders. The caps on these fuse lengths should be guaranteed to the user—to explode, and with a suitable waterproof electric spitter for ignition.

A. J. AVERELL.

Medford, Oregon.

A Poison Epidemic Among Wild Fowl

WE have become so accustomed to ascribing disease to various germs or organisms, that we may be disposed at times to overlook other possible sources of epidemics. A curious instance in point is reported from Utah, where the annual losses from disease among wild fowl in the Salt Lake valley become so great that the Biological Survey undertook an investigation of the causes. Somewhat similar conditions have been observed on certain lakes of California, Oregon, Montana and Kansas.

The birds affected with the disease become paralyzed, first losing their power to fly, and ultimately becoming entirely helpless.

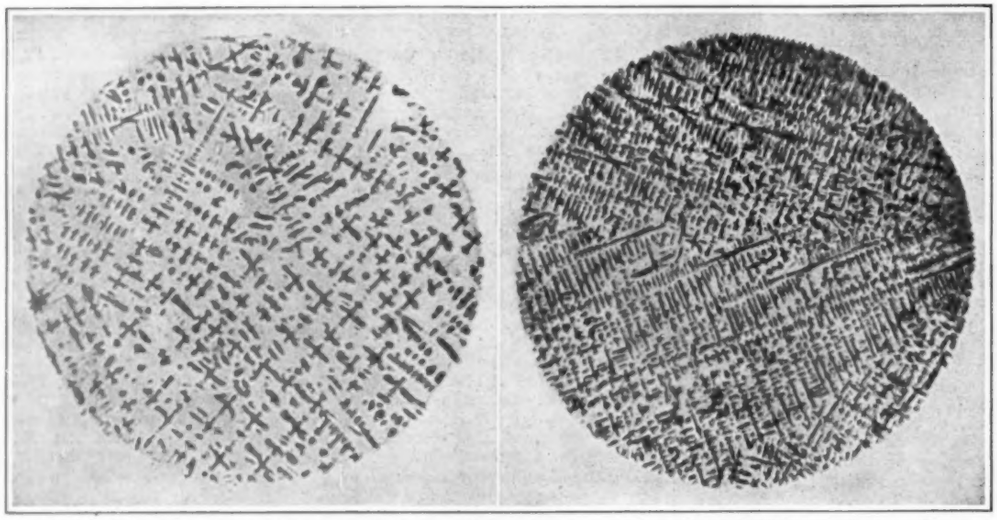
The investigation of the Biological Survey has established the fact that the disease is due to a poisonous action of certain salts (calcium and magnesium chlorides) which the birds take into their systems when feeding in water heavily charged with them. Such concentrated waters occur on the drying flats about the margin of Great Salt Lake, for example.

With the cause, the cure also is found. The birds, unless too far gone, recover when given a good supply of fresh water. This is a simple remedy when dealing with individuals, but it is not so easy to alleviate the general condition which depends on local circumstances. A system of draining the land and increasing the inflow of fresh water is what is needed.

Secrets of Antiquity

An Ancient Bronze Revived for Modern Service

By Robert G. Skerrett



Samples of bronze, magnified 25 times. Both are 100 parts copper to 10 tin; that at the left is made by ordinary processes, that at the right is Mr. Dawson's product, and shows a greatly superior grain

AT the Battle of Marathon, 490 B. C. the Persians were armed with bronze swords and spears, and the Greek victors are said to have been more pleased with these captured implements of war than they were with any of their other prizes.

In modern times metallurgists have striven to discover the secret of that ancient metal, but generally with only part-way success at best. None of the alloys of copper and tin have been at all comparable to that remote composition. The development of steel in its various alloyed forms made the technical world fairly satisfied that it could get along quite well without a knowledge of the bronze of the days before the Christian era. But it has dawned upon the engineering fraternity that steel does not meet with entire success some of the services now imposed upon it.

Here is a chance for a bronze akin to that produced in the far-off ages; and, strangely, after the better part of three thousand years, a seeming duplication of the long-lost mixture of copper and tin is now available, thanks to the tireless research of Samuel R. Dawson. Tests made of this composition by one of America's leading producers of alloy steels revealed the fact that Mr. Dawson's bronze when melted is peculiarly fluid; and because of this characteristic it was possible to cast shear-blades, table knives, etc., without any difficulty or losses, and these took and held a perfect cutting edge. By way of comparison, there were cast at the same time one or two heats of the identical formula of copper and tin, but lacking the inventor's secret "dope." The castings so made were inferior in strength, and several of them broke while being shaken out of the molds.

In reporting upon these experiments, the official of the steel company said: "The photomicrographs of specimens of Mr. Dawson's copper, and the same formula without the secret ingredient, show the former to have a much finer grain, which no doubt explains the property of taking and holding a keen cutting edge and the reason why those who have used it as bearing metal find it so superior to bearings made from the same formula but without the secret ingredient."

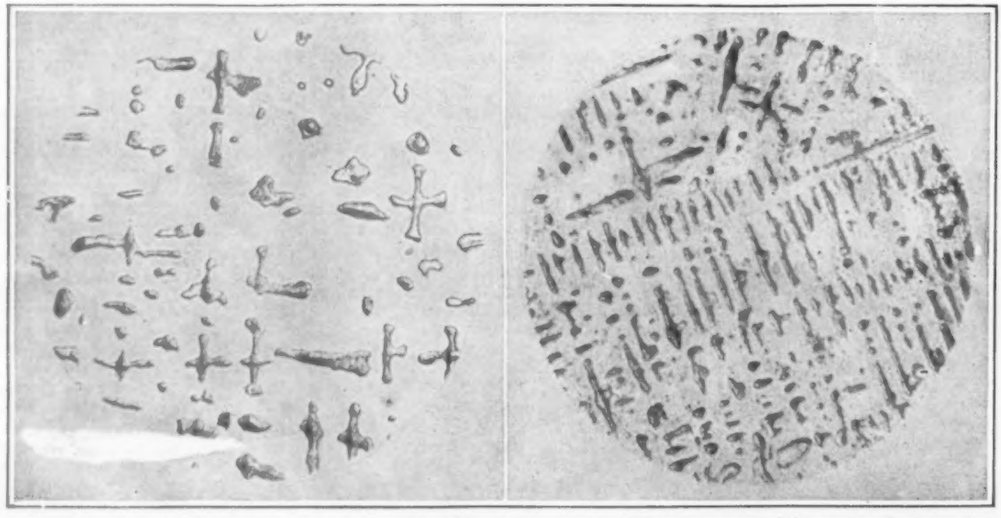
Probably one of the most convincing trials of the bronze for journal bearings was that recently made covering a period of 350 hours. The power shaft was 1½ inches in diameter, making 2,000 revolutions a minute, and supported by three bearings having each a width of 3 inches. The pulleys at the two ends received and transmitted energy, respectively, and the central bearing was, therefore, subjected to a double torsional stress. The bearing metal for the central journal was of the new bronze, and of the two flanking bearings one was lined with Babbitt metal and the other with regular composition. At the end of the test period, the composition bearing showed a wear of a little over 3/32 inch and was almost out of service; the Babbitt metal bearing showed considerable wear but nothing like as much as the composition; while the bronze bearing evidenced no wear that could be detected by any measuring instrument in the shop, and the journal was extremely smooth and very highly polished. The journal supported by the composition bearing gave signs of wear. In the matter of consumption of oil for lubrication, which was very carefully checked up by means of graduated oil cups, the bronze bearing used less than half the lubricant required for the composition bearing, and a third less than that for the Babbitt bearing. The Dawson bearing was remarkably cool.

THE development of the various alloy steels is the crowning achievement of modern metallurgy; but alloy steels are not enough. It has dawned upon the engineering fraternity that steel does not meet with entire success some of the demands that have been made upon it. In this article Mr. Skerrett tells us how a Brooklyn inventor has delved into the mysteries of the past, and found a way to make a bronze that seems able to do most excellently just the things that steel cannot do.

The significance of this performance becomes more striking when we realize that it is authoritatively stated that 75 per cent of our railroad accidents are due to hot boxes, where the axle bearings have become overheated through insufficient lubrication and the failure of the bearing metals employed. It is confidently claimed that the new bronze will radically reduce the number of these more or less serious and costly breakdowns, and it is believed that the amount of oil needed to insure proper lubrication will be lessened. Strange as it may seem, this is of prime importance to oilmen, inasmuch as it is said to be the practice of railroads to make yearly contracts not for so much oil but for the proper lubrication of the system. The burden of satisfaction, also the quantity of oil needful for this service, are the oilman's problem; and it is therefore to his advantage to meet these requirements as economically as possible.

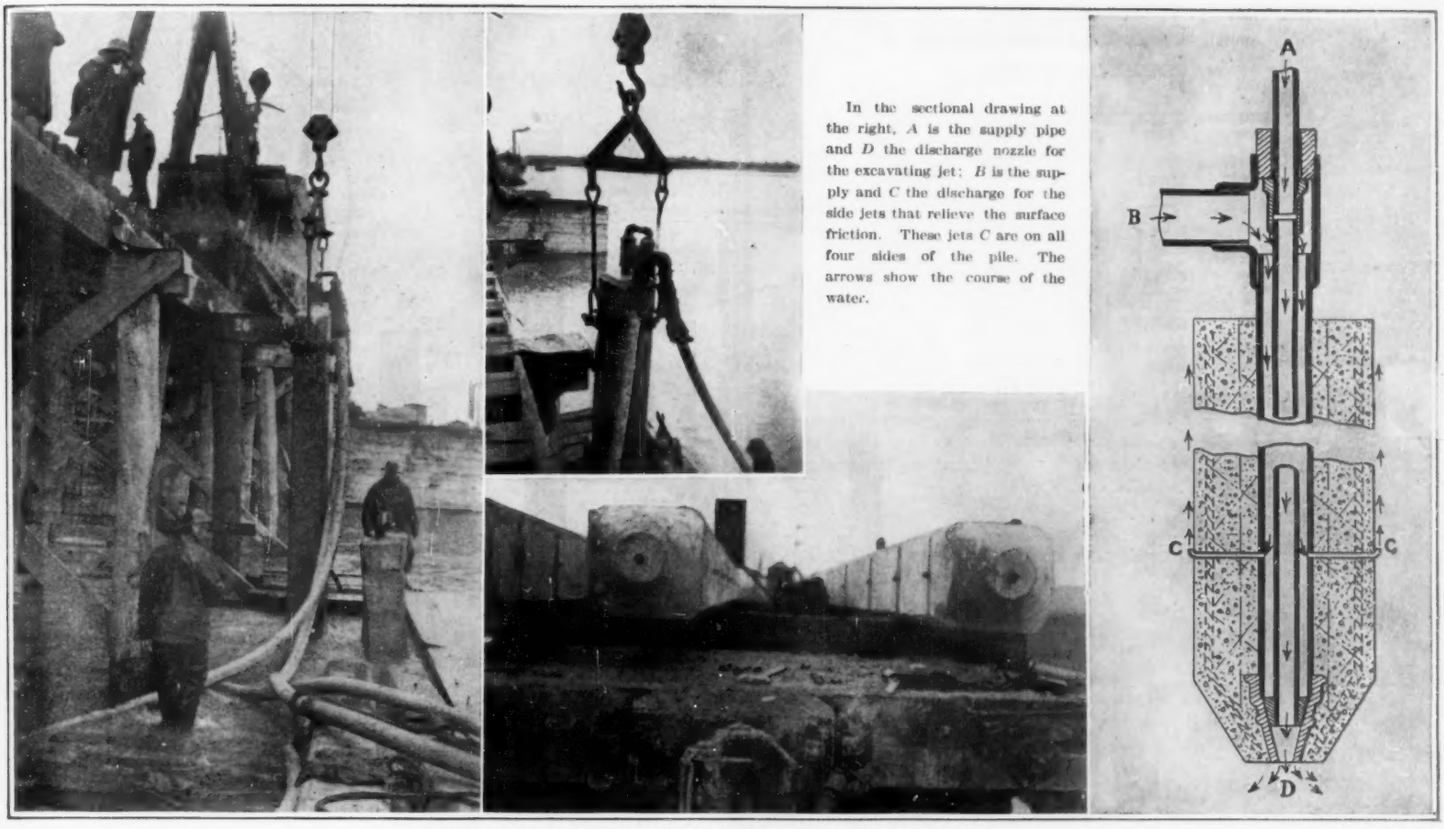
According to the findings of the U. S. Testing Laboratory at the Brooklyn Navy Yard, Mr. Dawson's bronze has a tensile strength of 34,000 pounds per square inch, the break showing no reduction of area and disclosing a sharp crystalline fracture. It has a resistance of 81,460 pounds elastic limit, and 200,000 pounds to fracture, per square inch. A bar of the bronze, 1 inch square, on 12-inch rests, will yield to a breaking strain slightly below 3,000 pounds, with a deflection of 16/100 inch—being thus about 25 per cent stronger than the best gray iron. It shows a hardness of 146, Brinell scale, or a fraction over that of annealed carbon tool-steel of the grade or quality used for drills, taps, and dies. The metal has a resistance of 140.05 ohms per circular mill foot, or a conductivity of 1/14th that of pure copper. It is electrically homogeneous.

The metal, when polished, has the luster and color of 14-carat gold. It is finely and uniformly crystalline throughout, and may be cast and recast any number of times without deterioration or *loss in weight*, always yielding smooth, solid, perfect castings no matter whether they be large and simple or small and complicated. The bronze can be drawn into wire as fine as 5/1000 inch, and may be rolled into extremely thin sheets. It possesses extraordinary resiliency without destroying its crystalline structure. It may be turned and milled in machine tools, where it behaves much like annealed tool steel. It is unaffected by electrolytic action, salt water, or fruit acids. It does not corrode or oxidize, and will not become roughened or pitted through exposure.



Samples similar to those above, but magnified 100 diameters. Again the better texture of the new product stands out clearly in comparison with the old

(Continued on page 294)



In the sectional drawing at the right, *A* is the supply pipe and *D* the discharge nozzle for the excavating jet; *B* is the supply and *C* the discharge for the side jets that relieve the surface friction. These jets *C* are on all four sides of the pile. The arrows show the course of the water.

The reinforced concrete pile that drives itself with jets of water

Left: One of the piles in course of sinking. *Above:* Top of pile, with hose attachments and lifting gear. *Below:* The pointed ends and projecting side-nozzles of the pile *Right:* A longitudinal section of the pile.

The Self-Sinking Concrete Pile

How Jets of Water Are Used to Bore the Hole and Relieve the Pressure Upon the Descending Sides

THE wooden pile is objected to in up-to-date engineering for a number of very good reasons. It used to be cheap, but is now an expensive constructional unit. It is all the more costly today because of the number broken and split in the driving. Finally, nature has definitely settled the timber pile's durability where it is called upon to furnish support partly in water and partly exposed to the air. That section of the stick which is alternately wetted and dried, day after day, is the point where oxidation promotes rotting, and the rest of the story is a familiar one. We all know that wooden piles are driven in a compact or crowded fashion frequently in order that enough strength can be secured to sustain a prescribed load—numbers being needed for this purpose owing to the character of the material thus employed.

It was due to these drawbacks that the concrete pile came into being a few years back. Since then, however, the engineer and the inventor have been busy improving these piles and seeking to modify both their get-up and the methods by which they could be planted in place. The hammering of a concrete pile into position was soon found to be objectionable. The driver was pretty nearly certain to damage the top of the pile if care were not taken, and, next, if the pile got out of the vertical during the hammering, the angularity of the blows set up stresses that often led to either a break or a serious amount of spalling—the latter at times freely exposing the metal reinforcement.

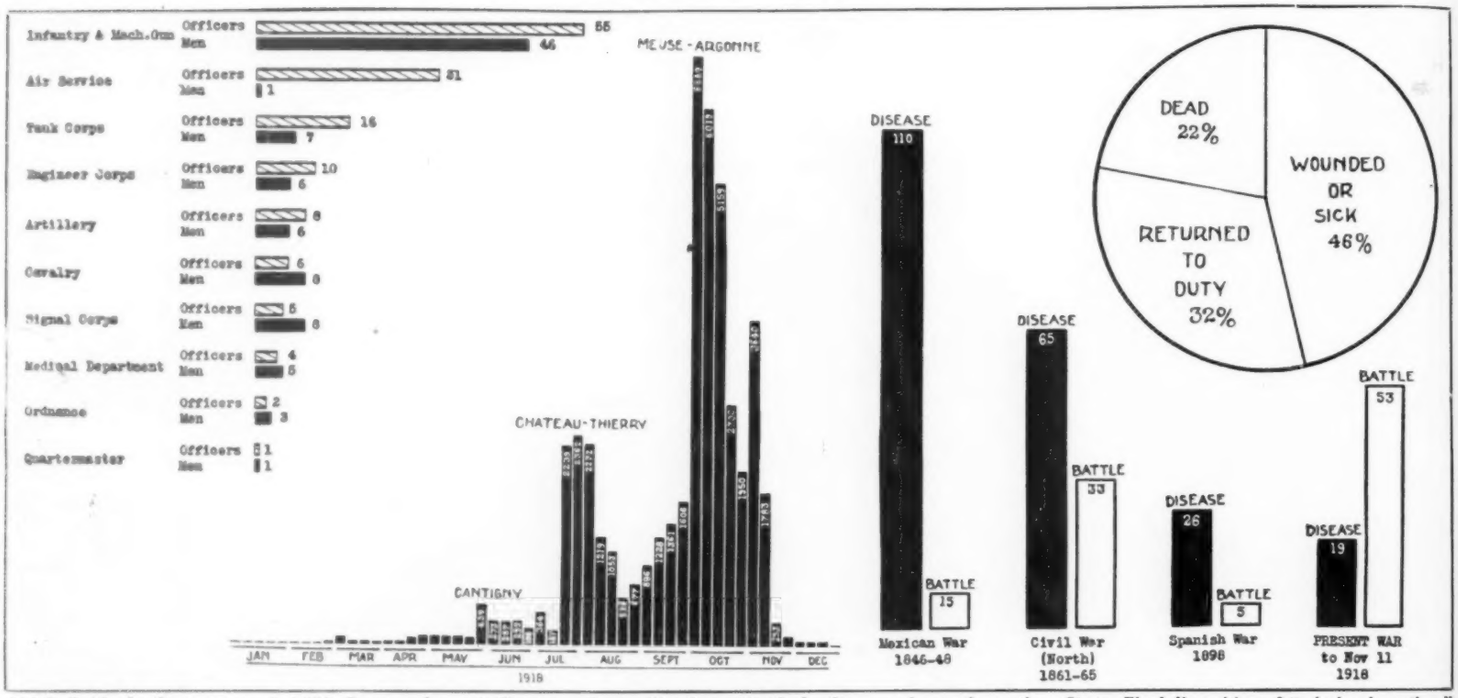
The latest development in the art is a self-sinking or self-planting pile which is decidedly unique in design and in its manner of functioning while effecting penetration. To begin with, the piling is a concrete column, built as a beam, with steel reinforcing, having in its center an opening which permits of the application of a water jet, and by which the primary excavational work incidental to penetration is accomplished. In addition, there are lateral side jets which promote the sinking of the piling by forming around it externally a water film—thus overcoming the frictional resistance of the earth, mud, or sand which would otherwise tend to exert a grip and to arrest downward movement. The water-jet system consists of two longitudinal conduits—one placed axially inside of the other—the larger being of 4-inch pipe and the smaller of half that diameter. The 2-inch pipe leads directly to the point of the pile, and through the nozle there a stream of water is driven out under a pressure of 200 pounds to the square inch. The 4-inch pipe supplies water at the same pressure, if need be, to the small lateral jets which have their discharge tips turned upward so as to direct the water vertically.

The upper terminals of the two pipes have separate flexible hose connections with the pumping plant so that the boring jet and the lubricating and scavenging jets can be operated independently. By this arrangement it is practicable to deliver to each conduit the volume and the pressure of water best suited to the conditions encountered. Further, this division obviates the difficulties which would be apt to arise if it were needful to subtract volume or pressure from the point jet to meet the demands of the side jets, and vice versa. The side jets, as will be readily grasped, not only maintain a lubricating film of water around the pile but they serve to carry surfaceward the material which is displaced by the pile during its sinking, thus supplementing the action of the excavating jet at the point below.

Inasmuch as the piling sinks by reason of its own weight, it readily assumes the desired measure of penetration without being struck a single blow, and, accordingly, is not subjected to any damaging stresses in getting it into place. Depending upon the skill of the crew one of these concrete columns can be planted in the course of five minutes from the time it is set in position and started downward. Immediately after the jets are turned off, the earthy material through which the pile has been sunk will settle around the column, grip it, and hold it as firmly as if it had been driven in the usual way. The nozzle at the bottom of the new pile closes the lower end of the 4-inch pipe, and, also, furnishes a wedge-shaped footing for the 2-inch conduit. The latter pipe, together with the hose connections at the top of the piling, is arranged to facilitate rapid attachment and detachment—this pipe and the connections being used repeatedly in sinking other concrete columns. The 4-inch pipe, which remains embedded in the piling, thus becomes a permanent reinforcing member, and augments the rest of the steel work built into the column.

It will be apparent that the pile, during sinking operations, can be readily withdrawn if needful. This is an admirable feature, because the weight of the entire concrete shaft can be made to serve as a giant cold-chisel by letting it drop again on any buried object which stands in the way of its progress. Where such obstructions are to be expected the point of the pile is protected by an enveloping driving shoe of steel. This suffices to break the way clear without inviting injury to the concrete column. Where it is desirable to sink the piles well below the tidal level, pipe connections of sufficient length are brought into play at the tops of the piles so that the planting of the concrete columns can be controlled down to any desired depth below the surface of the water. Subsequently, in breaking these connections, the 2-inch pipe within the pile is withdrawn simultaneously. Concrete piles of this character, 50 feet long and 16 inches square in cross-section have been sunk in 48 feet of sand and clay and satisfactorily subjected to test loads up to 100,000 pounds per pile.

Up to the present time, the principal use of this type of premolded reinforced concrete pile has been in connection with obstructions planted in the beds of the Missouri and the Platte Rivers. There, in addition to the gravel, sand, and silt ordinarily penetrated, both clay and "gumbo" have been encountered and negotiated successfully. Experimental sinkings in alluvium and underlying materials on higher ground have likewise proved entirely satisfactory. Apropos of the facility with which the piles can be planted with their heads well below the bed of a river, Professor O. V. P. Stout, Dean of the College of Engineering of the University of Nebraska, says: "Advantage has been taken of this fact to inaugurate a new system of bank protection where railway grades, farm lands, or other property is endangered by the destructive action of river currents. The method has established a claim to consideration on the grounds of cheapness and expedition; and it is believed that time will demonstrate that it has the added merit of permanence." This story will be told in detail in an early issue of the SCIENTIFIC AMERICAN.



At left: **Battle deaths among each 1,000 officers and men in France.** *Center:* **Number of battle deaths occurring each month.** *Circle:* **Final disposition of "missing in action."** *Below:* **Disease and battle deaths per 1,000 per week in this and previous wars**

Our Technical Achievements in the Great War—VIII

How the Physician and the Surgeon Mitigated the Horrors of War

HAVING in mind the destructiveness of the great war, it will come as a surprise to many to learn that, of every 100 American soldiers and sailors who took part in the war with Germany, only two were killed or died of disease as long as hostilities lasted. To know how satisfactory a record this is, we have only to turn to the statistics of the Civil War, when the casualties in the Northern Army were 10 per 100. Among the other great nations in this war, between 20 and 25 out of each 100 men called to the colors were killed or died. "To carry the comparison still further," says Col. Leonard P. Ayres, "American losses in this war were relatively 1/5 as large as during the Civil War, and less than 1/10th as large as in the ranks of the enemy or among the nations associated with us."

In the opinion of our military officers this war was the bloodiest which has ever been fought, with the possible exception of the Crimean War, in which the casualties per 100 men were equally heavy. The British forces in the Crimean War lost 22 of every 100 men; the French 31; the Turkish 27 and the Russian 43. But it should be noted that 4/5 of these losses were from disease; whereas in the recent war with Germany, deaths from disease were inconsiderable as compared with deaths in battle. The forces engaged in the Crimean war were, of course, very much smaller.

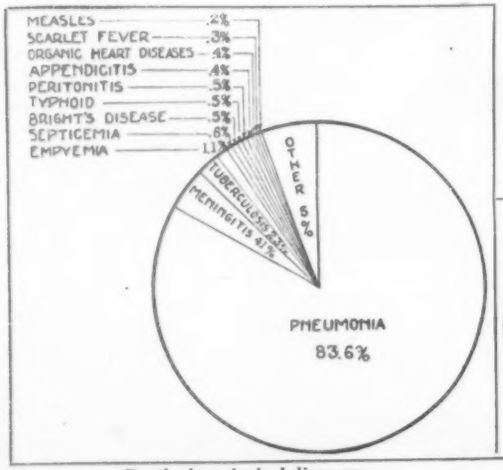
The total deaths in battle of the recent war were greater than all the deaths in all the wars for over a century previous. Our military men estimate that from 1793 to 1914 the total deaths in war were somewhat under 6,000,000. The battle deaths alone during the four years, 1914 to 1918, show the frightful total of 7,450,000. An estimate of the losses of the principal nations engaged is shown in the accompanying table:

Battle Deaths in Armies Engaged in Present War, 1914-1918

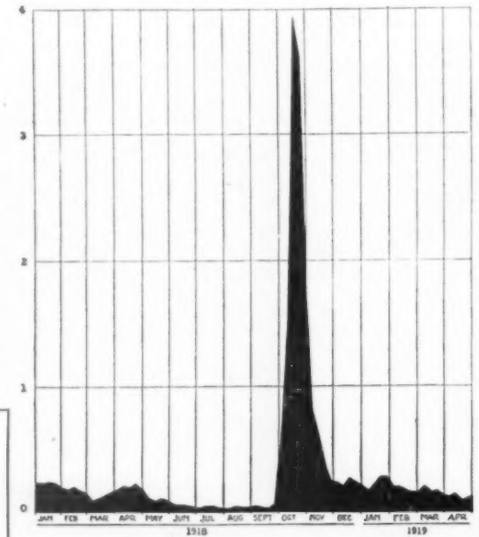
Russia	1,700,000
Germany	1,600,000
France	1,385,300
Great Britain	900,000
Austria	800,000
Italy	330,000
Turkey	250,000
Serbia and Montenegro	125,000
Belgium	102,000
Roumania	100,000
Bulgaria	100,000
United States	48,900
Greece	7,000
Portugal	2,000
Total	7,450,200

It should be understood that only deaths resulting directly from battle are included in this table. The total deaths from all causes, including disease, acci-

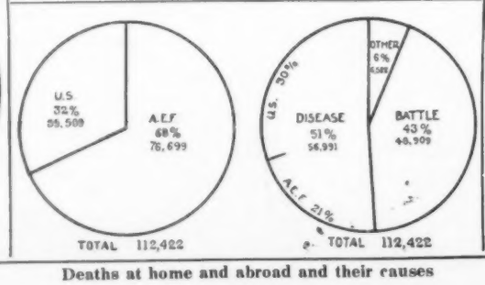
(*Continued on page 296*)



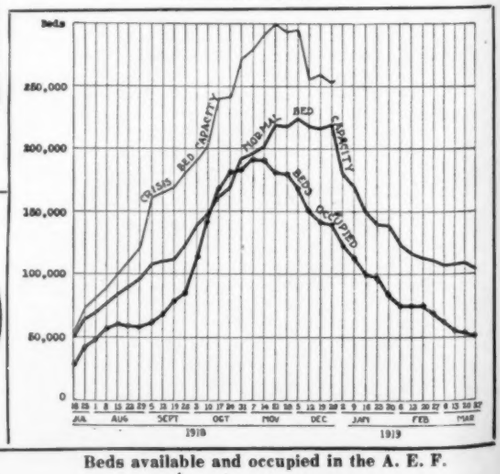
Deaths by principal diseases



Deaths per 1,000 soldiers in the United States, showing effect of influenza epidemic



Deaths at home and abroad and their causes



Beds available and occupied in the A. E. F.

Making the Desert Bloom in Australia

An Irrigation Scheme on the Island Continent That Involves Big Construction Work

By Oliver Johnson

ONE of the world's greatest irrigation schemes, the Murrumbidgee Irrigation Area, comprises about 1,250,000 acres of virgin land situated in one of the most fertile parts of New South Wales. The existing rainfall over this area is not sufficient to enable the best results to be obtained, but irrigation as now applied is converting what has hitherto been ordinary grazing country into what will eventually become one of the most intensively cultivated districts in the Southern Hemisphere.

A striking illustration of what can be accomplished by irrigation is shown on the Yanco Experimental Farm, New South Wales. The average annual rainfall over the above area is about 16 inches, of which 7 inches falls during winter months, the remaining 9 inches falling in the summer months, during which period irrigation is necessary to supplement the rainfall. It naturally follows that an enormous body of water must be conserved to irrigate such a vast expanse of land as 1,250,000 acres.

The most striking feature of the conservation works is the great Burrinjuck, which, when completed, will be the second largest dam in the world. An expanse of 8,000 square miles of rugged gorges and mountain-peaks rising to an altitude between 2,000 and 5,000 feet forms the watershed of the Murrumbidgee River. Where the enormous dam has been constructed the Murrumbidgee presses through a gorge that narrows so remarkably as to make it appear that nature herself had foreseen the contingency of the erection of this great dam. Across this gorge a barrier has been flung. The dam when completed will have a maximum height of 240 feet with a base 170 feet thick, tapering to 18 feet at the top, and will throw back the waters into a lake covering 12,740 acres, reaching one way a distance of forty-one miles, in another fifteen miles, and for twenty-five miles in a third direction. Its volume is at present sufficient for requirements, and eventually will be 33,000,000,000 cubic feet, or 766,324 acre-feet—that is, sufficient water to cover that area to a depth of 1 foot.

The liberated waters from the dam flow down the natural channel of the Murrumbidgee for 220 miles to the Berembed diversion weir, which turns the irrigation water into the main canal, which, when completed, will discharge 2,000 cubic feet per second. From the main canal, distributary channels deliver supplies of water to each separate farm, and the drainage channels remove surplus water after irrigation. All the water runs from the storage dam to the irrigated farm by gravitation, thus enabling the water to be supplied at a remarkably low rate. The water is supplied to each holding by means of a Detheridge meter, and each farmer knows exactly the minimum volume of water to which he has a right. This is measured in acre-feet and charged for at five shillings per acre-foot per year. The areas of the farms are from 2 acres to 200 acres, and the range of products varies considerably. The larger holdings are devoted to dairying, lamb raising, or mixed farming, and on the Murrumbidgee Irrigation Area there is a butter factory capable of dealing with the products of ten thousand cows. In addition to this, cheese, bacon, and fruit-canning factories are also established. Fat lamb raising has always been a lucrative industry, and on a mixed farm can always be relied upon to yield a handsome return. To the fruit and vegetable grower irrigation is a priceless boon. On the Yanco Experimental Farm peaches, apricots, nectarines, prunes, pears, walnuts, almonds, melons, and citrus fruits, also wine and table grapes, raisins, sultanas, currants, figs, and olives, grow to perfection under irrigation, and returns from £40 to £200 per acre have been obtained. Tomatoes, beans, cauliflowers, asparagus, and cabbage yield handsome profits, and the Chinese claim to have produced tomatoes which gave a gross return of £400 per acre. Poultry farming and ostrich farming are profitable industries, as everything in the shape of food is produced on the farms, consequently the profits go direct to the farmer.

The ideal conditions for an economical storage are those where a narrow rocky gorge exists below an area of extensive river flats. When all such sites have been located, it is desirable to utilize the one which has the largest catchment area above it, regard being paid at the same time to the capacity of the storage to fairly regulate the winter and summer flows. The actual site decided upon for the Burrinjuck storage wall is in a deep gorge below the confluence of the Goodradigbee and the Murrumbidgee Rivers, where the river channel is confined between two high walls of solid red granite.

The whole of the flow in the channel of the Murrumbidgee River is practically contributed by the effective catchment situated above the town of Gundagai. The area above this point, which is 8,000 square miles in extent, varies from elevations of 5,000 feet, which are snow-covered every winter, and have an average annual rainfall of 60 to 70 inches, to lower plateaus of not more than 2,000 feet in height, where the average annual rainfall does not exceed 26 inches. The flow of the Murrumbidgee fluctuates between the extremes of the flood volumes which are afforded by the combined rains and melting snows of the spring, and the extreme low water of midsummer, which is contributed from the springs scattered over the higher portions of the catchment area.

The open river flats at the junction of the Goodradigbee and Murrumbidgee Rivers provide a storage capable of regulating the flow of the catchment area of 5,000 square miles which exists above that point. When the storage dam is full to overflow level, these flats will be covered with a depth of 150 feet of water. This regulated flow will then be used to sup-

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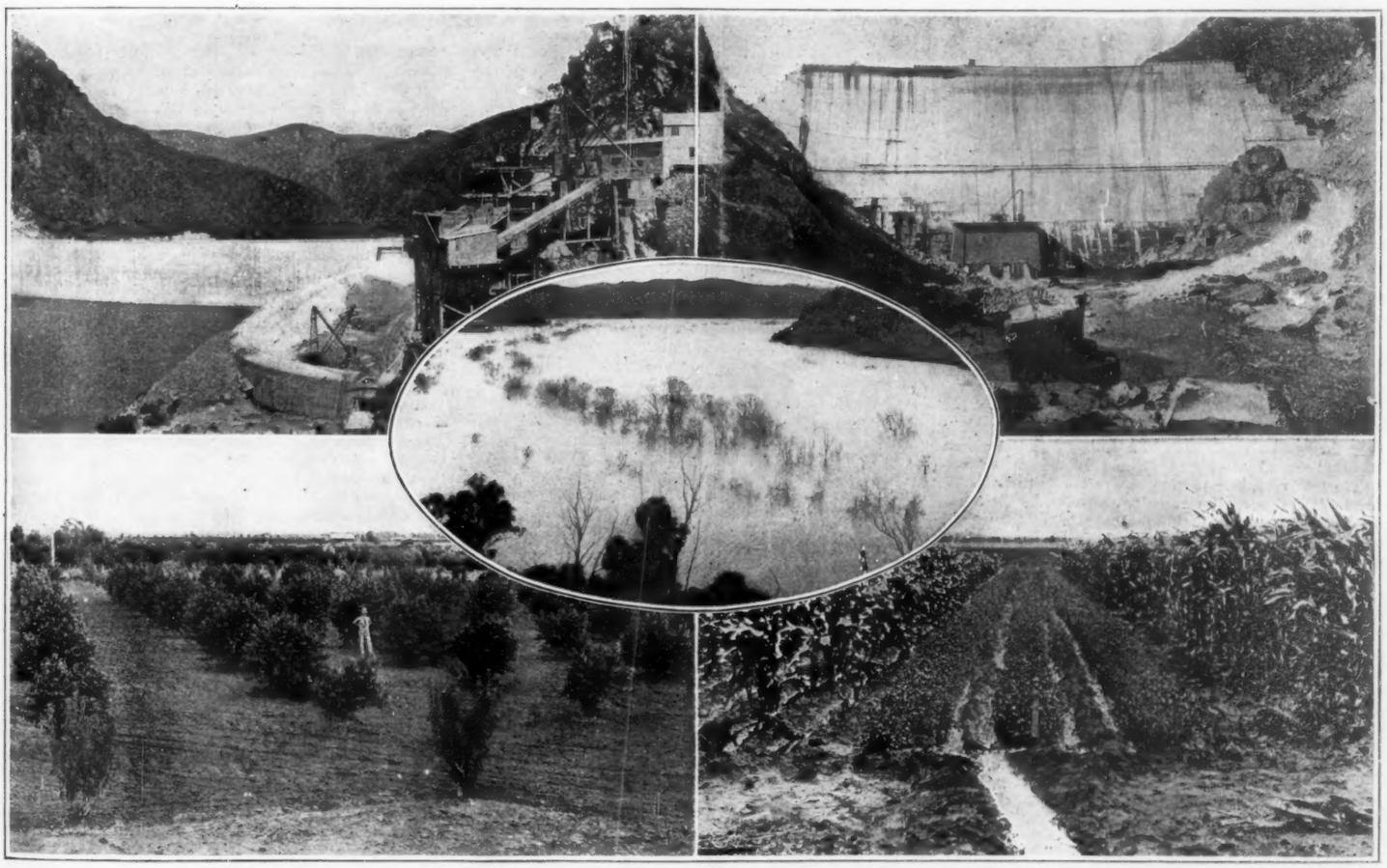


At the top: Views of the Burrinjuck Dam from above and below. *At the bottom:* 2-year-old peach trees (left) and experimental plot of beans (right) on irrigated land. *In the center:* The land overflowed by the water behind the big dam

The Service of the Chemist

A Department Devoted to Progress in the Field of Applied Chemistry

Conducted by H. E. HOWE, Chemical Engineer

Alcohol in Industry

AT this time when alcohol is receiving so many knock-out blows and is the subject of so much serious and humorous discussion, it may be informing to outline something of its better and more useful side. Beverage alcohol and alcohol in beverages seem to be fairly well recognized as destructive agents, but alcohol both pure and denatured holds such a place in industry that many believe we can never hope really to compete with Germany in certain fields of industry until it can be made more easily available to our manufacturers.

Let us recall that by alcohol we mean pure grain or ethyl alcohol and by denatured alcohol we indicate the grain variety to which has been added some 10% of a material acceptable to the Internal Revenue authorities as a substance which in the quantity present will render the alcohol unfit for beverage purposes. These kinds of alcohol are always produced from carbohydrates by fermentation methods. The raw materials differ according to economic conditions. Thus Germany has made a specialty of growing potatoes having a very high starch content though unattractive as human food, while we find it more profitable to use starch derived from our great corn crops. Much alcohol is produced from molasses of a grade not suitable for table consumption and in some plants cores, peelings, and other carbohydrate-bearing wastes form the raw materials. Flavor is of no consequence, so that limitations on raw materials are wholly economic.

The cheapness of sawdust and its general uselessness led to its employment as a raw material for grain or ethyl alcohol production by a chemical and fermentation process which has been described previously. The cellulose of the wood is first converted to a soluble sugar.

There is no reason to believe that the more extensive use of alcohol in the arts will necessarily make inroads on food stuffs, for we could grow enough cellulose annually for our alcohol requirements provided sufficient waste materials were not available.

It is now thirteen years since we took our first important step toward making alcohol available at a lower price for our industries and the time seems present for still other steps designed to remove limitations which experience has shown to be impeding our progress. It was indeed well for our country that industrial alcohol production had been encouraged, for when war came munitions required ever increasing quantities until in 1918 nearly 52,490,000 proof gallons were used. The following table from the report of the Commissioner of Internal Revenue shows the growth of the industry:

Fiscal Year.	Denaturing Warehouses.	U. S. Gallons 90-95% alcohol.
1907	8	1,780,276
1908	12	3,521,452
1909	12	4,556,419
1910	12	6,079,027
1911	14	6,881,130
1912	14	8,094,515
1913	21	9,831,659
1914	25	10,404,976
1915	23	13,986,469
1916	33	46,679,106
1917	44	55,679,598
1918	40	50,163,016

The decrease in 1918 was due to the cancellation of certain large orders for munitions. As distinguished from warehouses there are approximately 65 alcohol producing plants in the United States working with an investment estimated at $350,000,000 and making about 700,000 wine gallons of industrial alcohol daily.

We are able to supply the alcohol we need. The whole difficulty seems to be in the unnecessary cost incident to this production. The regulations made thirteen years ago were designed to make it hard for the illicit still and were adopted before we had any such chemical and pharmaceutical industry as we now possess. Uses have arisen where the denaturants act as impurities which cannot be tolerated and due to our laws the manufacturer finds it necessary to use quantities of alcohol upon which there is a tax of $4.18 per gallon above the manufacturer's price. Denatured alcohol, in quantity, 180 proof, was quoted during July at from $0.40 to $0.43 per gallon and even that cost could be materially reduced if certain expensive regulations could be avoided. Several good suggestions have been made, but let us consider why it is worth while to have the kinds of alcohol as cheaply as may be to suit the specifications of industry.

A great many processes are carried out in solutions and alcohol is one of our important solvents. It may also be used to cause the precipitation of substances insoluble in it by adding alcohol to solutions of them in other solvents. Alcohol comes second to water in importance as a solvent and it was this use of it that brought it into prominence in munitions. Alcohol is largely used as a solvent in the dye industry and in pharmacy for the preparation of extracts, tinctures and as a diluent. It is also employed to a large extent in the manufacture of shellac and varnish, while it is essential in compounds for the removal of these same finishing materials. Until recent years the lacquers used on high grade instruments were prepared years in advance from the best of shellac and absolute alcohol, which is the term used to describe pure ethyl alcohol from which water has been removed as completely as possible, the last traces offering considerable difficulties in separation. The lacquers which are displacing these older types also employ alcohol either alone or in mixture with other solvents.

The differences in solubility in alcohol offer an excellent method for purification and crystallization. As an example may be cited the separation of potassium and sodium hydroxide which is so trustworthy that labels on potassium hydroxide chemically pure frequently bear the legend "purified by alcohol." Transparent and liquid soaps also require alcohol. It enters into the production of perfumes, toilet waters, some shampoo preparations, and takes further part in the beauty parlor through the increased efficiency secured in the deposition of silver in making mirrors when alcohol is present in the silver solution. Non-corrosive soldering fluxes often contain alcohol.

It would not be difficult to show the universal use of solvent alcohol in some form in nearly all industry if its employment as such and in combination with various solutes were to be traced and tabulated. Thus since it finds use as a solvent for nitro-cellulose products, we could properly list artificial silk, gas mantles, motion picture and other photographic films, artificial leathers, patent leathers, pyroxylin plastics, and collodion. But it also fills a demand as a raw material.

Alcohol plays a part as a raw material in the manufacture of such materials as ether, chloroform, acetphenetidin and mercury fulminate. There is a considerable list of chemicals and drugs into which alcohol enters in this way and we have come to regard most of them as essentials.

The importance of alcohol as a fuel and the probability that it will find extensive use as such in the not too distant future must be borne in mind. At present a comparatively small quantity of alcohol is so used due largely to the great amount of relatively cheap petroleum products still available, yet its lack of carbonization and its smokeless flame make it unrivaled for chafing dishes and the like. Its advantages have also been recognized for lighting systems equipped with mantles which owe their luminosity to the high temperature to which they are heated. Alcohol burners for high temperatures have long been used in laboratories where gaseous fuels were not available, while various compounds capable of retaining the fluid have been put upon the market of late years as "solid alcohol" for heating purposes.

Those who study the engine fuel problem find much of interest in alcohol as such or as a component of a blended fluid. One investigator has run an automobile more than eleven thousand miles on such a blend without carbon having been deposited in his engine, notwithstanding the belief that most of such carbon results from the lubricating oil rather than the fuel. There is a theory that carbon in internal combustion engines is really a mixture of silicious dust, oil and tarry matter with the carbon and when alcohol is the fuel there is a tendency for the oil and tarry matter to be dissolved, thus releasing the other components which then blow out with the exhaust. There are some who advocate burning some alcohol with gasoline for this purpose. While alcohol does not produce as many heat units per volume as does gasoline or does not have the same calorific units per pound in the usual gasoline motor, the theoretical power is never developed. When alcohol is used in an engine designed especially for its combustion the difference is greatly reduced and there is reason to believe that eventually practically the same power will be realized.

We must bear in mind that there has been far too little co-ordination in research upon internal combustion motors and fuels for such engines. A few years ago the effort was to consume all the fuel produced, but the manufacture of motors has gone forward so rapidly that we shall soon be concerned to find satisfactory fuel for existing motors. Nearly all these motors seem to have been designed with the idea that a uniform grade of fuel was always to be available. The one-time abundance of such fuel undoubtedly contributed to the stimulation of the production of motors, but already these motors have led to the development of cracking processes, etc., in an effort to obtain the utmost from our petroleum supplies while new researches have been initiated looking to new fuels. This is not to be construed as meaning that we face an immediate shortage in gasoline, but there is food for thought in the fact that our annual consumption of crude petroleum is above three hundred and thirty million barrels, while the Geological Survey estimates our reserves at about seven billion barrels. It seems certain therefore that in the near future engine design must take into definite consideration the characteristics of the fuels which may be available. Good results have been obtained with mixtures of benzole, alcohol and gasoline, and alcohol has given some promise under such exacting requirements as airplane motor fuel. There is something very fascinating in the possibility of growing our motor fuel each year using wastes for much of it, employing cellulose of no value in other directions and in using a cleaner, safer fuel.

It has been shown that alcohol has no peer as a safe, non-corrosive, anti-freeze solution for motor radiators. Those compounds containing calcium chloride are distinctly harmful and while alcohol evaporates and must be replenished its complete safety offsets any other disadvantage. The use of glycerine to reduce the loss of alcohol is not to be recommended, since in quantities to be effective it attacks rubber connections. An alcohol-water mixture of 0.988 specific gravity contains 10% alcohol and freezes at 27°F. 30% has a specific gravity of 0.968 and is for use at 10°F. For —2°F. 40% corresponding to 0.957 must be used while 0.943 indicates a 50% alcohol solution and may be used down to —18°F. When using such solutions the hydrometer is the most dependable measure.

In condemning alcohol as a destructive agent we must not overlook the fact that under very many conditions it is an important constructive material and as such its production needs encouragement as well as laws which control without making it difficult for those industries depending upon it to have suitable grades at lowest prices.

Fifth National Exposition of Chemical Industries

AFTER four successful expositions in New York, each on a larger scale than its predecessor, the Fifth National Exposition of Chemical Industries will be held this year in Chicago, September 22-27. The development of the industry as displayed by the exhibition has been of deep interest to chemist, manufacturer, banker and layman, while each year has brought out something new and important. This year a feature will be made of electric furnaces, new metal alloys to resist acids and alkalies, organic chemistry as a factor in peace as well as war, new apparatus and paint equipment. The United States Bureau of Mines will exhibit a variety of appliances designed for the safety of workers in plant, factory and mine. It is expected that the exhibition will be the means of interesting many in industrial chemistry who have heretofore considered it of no importance to them.

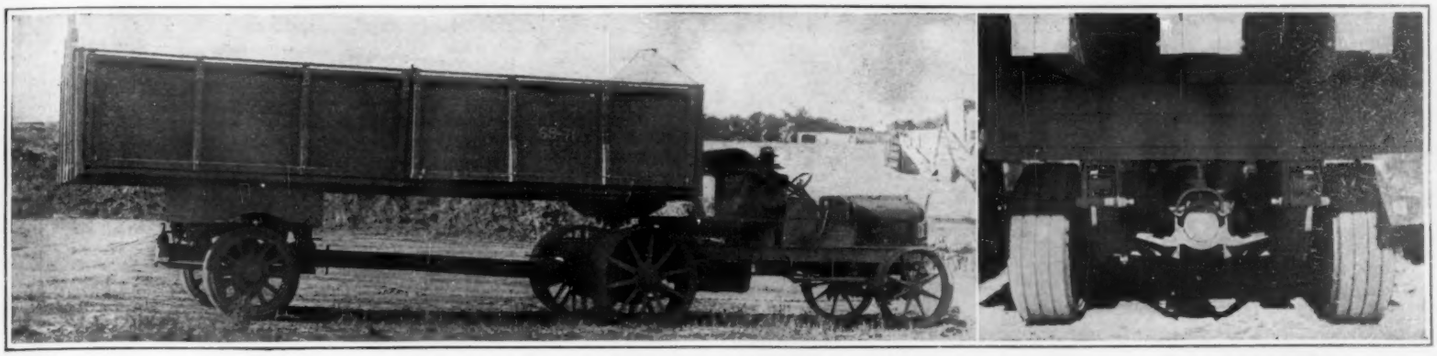
A Van Hise Memorial

AN alumni memorial in honor of the late President C. R. Van Hise, of the University of Wisconsin, is proposed in the form of a Van Hise Memorial Geological Building, to house the department of geology and mining engineering of the university and the state geological survey.

The Motor-Driven Commercial Vehicle

Conducted by MAJOR VICTOR W. PAGÉ, M. S. A. E.

This department is devoted to the interests of present and prospective owners of motor trucks and delivery wagons. The editor will endeavor to answer any question relating to mechanical features, operation and management of commercial motor vehicles



A short-wheel-base semi-trailer chassis, and a detail view of the suspension

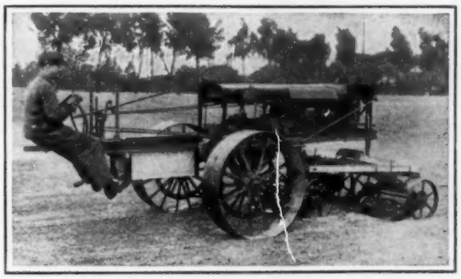
Large Semi-Trailer Outfit

FOR transporting extremely bulky and heavy loads such as large structural iron shapes, lumber, logs, etc., the semi-trailer method greatly increases the hauling power of any standard truck and in recognition of this fact, a number of truck manufacturers are marketing short wheelbase chassis equipped with a turntable arrangement intended only to be used as the tractor of a semi-trailer outfit. The accompanying photographs depict what is said to be the largest trailer yet built as it has a capacity of fifteen tons and is utilized in hauling farm supplies and products in Solidad, California. The tractor is an adaptation of a five-ton truck of well-known make, equipped with steel tires all around as it is used mostly on unpaved, roads and the large area of the tires keeps the heavily loaded wheels from sinking too deeply into the soft road or field. The box body is a special side-dump type, the sides being hinged at the top. Another feature of interest is the use of a pole to provide the greater part of the tractive pull or draft, this joining the trailer axle with a suitable drawbar arrangement on the tractor frame. The direct rear view shows the heavy construction of the trailer axle, the substantial semi-elliptic spring suspension and the exceptionally wide solid rubber tires necessary to carry the load without injuring the road surfaces. The pole is attached to both the front and rear extensions of a sub-frame bolted to the axle, by simple screw clamps, which make it possible to disengage it easily when necessary and yet hold it securely when at work. The pole also serves as a torque or radius member and reduces much of the twisting strains on the trailer springs that would result from transmission of all the draft by these members.

New Use for Motor Cultivator

THE use of horse-drawn mowers for keeping down the growth of grass on golf-course fairways has a number of disadvantages, so motor-propelled cultivators have been found well-suited for this work, as shown in accompanying illustration.

Recently, owing to the wet weather, it was found impossible at the Kickapoo Golf Links at Peoria, Illinois, for the golfers to play any kind of a game as long as horses were used to mow the links. There were



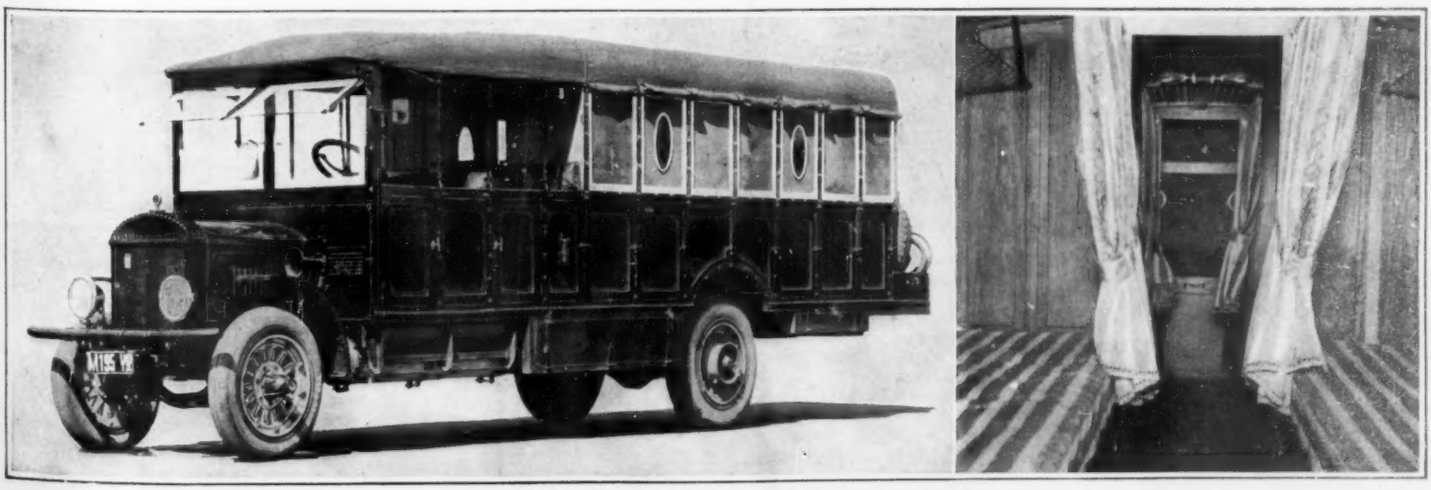
The cultivator for the mowing job

too many big hoof imprints into which the ball could fall. One of the members of the golf club suggested that they look about for some better method of mowing the course. The method seized upon and tried out was that of pushing the mowers with motor power. A cultivator, one of the standard machines turned out by a local tractor manufacturer, was used. It was built for regular farm work such as planting and cultivating row crops and for doing light field and belt work, but when they hitched the mower to the motor cultivator and started across the course, it was seen at once that they had hit upon a method of mowing that would far surpass the horse mower method, both in the saving of time and in the quality of the job. Incidentally this cultivator can be used, with only slight changes in the attachments, for raking the golf course and doing various odd jobs about the park. This is certainly an advancement over the old method in many ways and it will only be a very short while before this or a similar method is adopted by golf clubs, park boards, and by care-takers of all places where there are large spaces of grass to be mowed and kept in good condition.

A Real Hotel on Wheels

MANY caravan bodies have been devised for motor truck chassis to provide living accommodations on a mobile vehicle so the locality of the quarters could be changed as conditions demanded. Some of these modern "prairie schooners" have been very simple, others have been fitted up luxuriously. None that have been brought to our attention have been as sumptuous as the hotel on wheels illustrated herewith. The exterior view shows that it is practical and pleasing in appearance, the interior depicts the comfortable furnishings evidently based on Pullman car practice to some extent. Thousands of people at the recent Indianapolis races viewed this caravan with envy. It is complete to the last detail. There are sleeping compartments for four people, with glass windows that can be raised and lowered, in the side of the body. Beneath each sleeping compartment is a commodious chest for

(Continued on page 298)



Interior and exterior views of a motor-truck travelling hotel

SKY LUBRICATION

TRANSATLANTIC flights are about to become every-day affairs. Governments and private corporations are laying plans to establish passenger and freight service between nations and hemispheres.

Continents clasp hands.

To man's dominion over the earth and the seas is added man's dominion of the skies.

Aerial mails speed up business. Aerial forest patrols guard the nation's timber. Aerial fire fighters will protect property in sparsely settled regions.

Time is given new value. Distances are annihilated.

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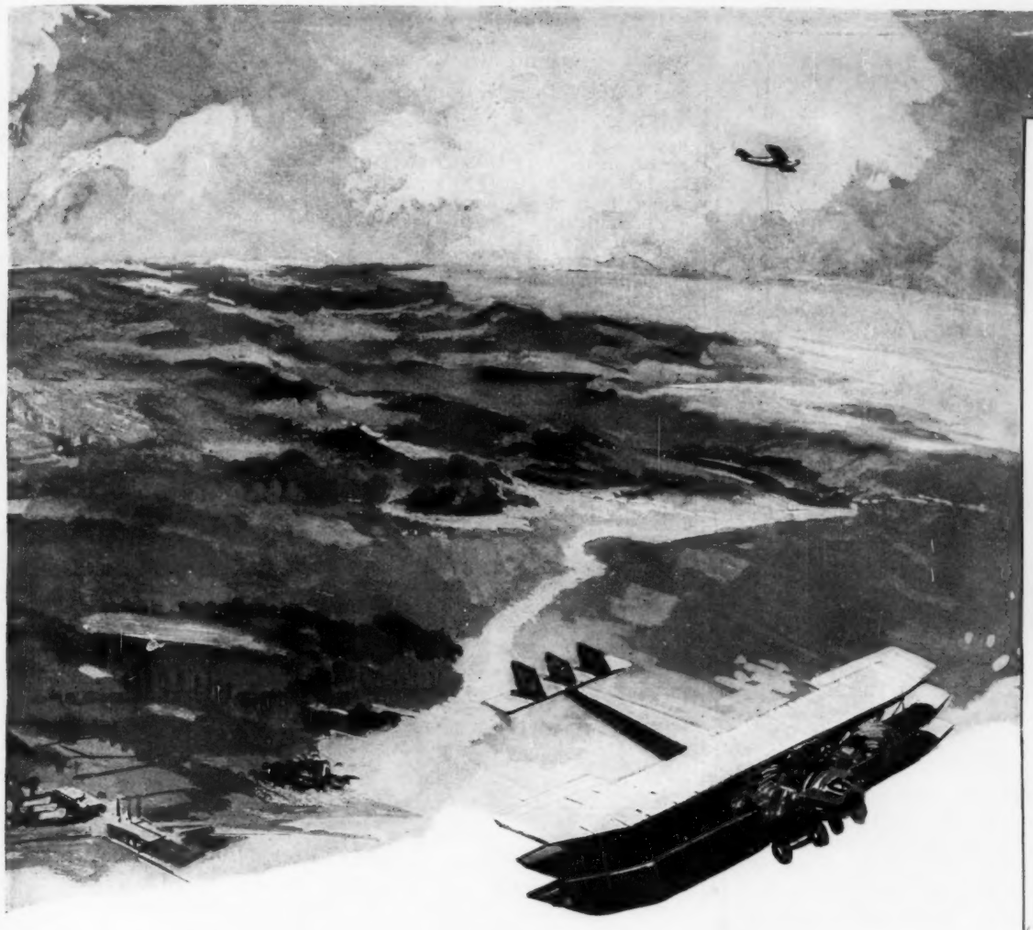


THE correct lubrication of aircraft is naturally a matter of great importance. Guesswork and theorizing characterized the early lubrication of aircraft—just as they characterized the early lubrication of automobiles.

The Vacuum Oil Company has placed aircraft lubrication on the same scientific basis that characterizes its lubricating recommendations for all types of machinery. The Aircraft Lubrication Chart specifies the correct oil for the leading types of aircraft engines. Write us for information about the correct lubrication of any aircraft engine.

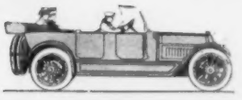
The further development of air travel will continue.

The work must go on.

GARGOYLE

Mobiloils

A grade for each type of motor



Correct
AUTOMOBILE LUBRICATION

GARGOYLE

Mobiloils

A grade for each type of motor

Gargoyle Mobiloils for engine lubrication are

Gargoyle Mobiloil "A"
Gargoyle Mobiloil "B"
Gargoyle Mobiloil "E"
Gargoyle Mobiloil Arctic

The Chart below indicates the grade recommended by the Vacuum Oil Company's Board of Engineers. The recommendations cover all models of both passenger and commercial vehicles unless otherwise noted. If your car is not listed in the partial Chart, send for booklet "Correct Lubrication" which lists the correct grades for *all* cars.

AUTOMOBILES	1919 Models		1918 Models		1917 Models		1916 Models		1915 Models	
	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter	Summer	Winter
Allen	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Auburn (4 cyl.)							A	Arc	A	Arc
Auburn (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Auburn (6-38)				A	Arc	A	Arc			
" (6-39) Teetor-H			A	Arc						
Autocar (2 cyl.)	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Briscoe	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Buick	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Cadillac (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
Case	Arc	Arc	Arc	Arc	A	Arc	A	Arc	A	Arc
Chalmers			A	A			Arc	Arc	Arc	Arc
" (6-40)							A	Arc		
" (6-50)	A	A			A	A	A	A		
Chandler Six	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Chevrolet	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A						
" 6 (F.A.)	A	Arc	A	Arc						
Cole							Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	A	A
Cunningham									Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Dart	Arc	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" (Model C)					A	Arc	A	Arc		
" (2 and 3½ ton)	A	A	A	A						
Dodge Brothers	A	Arc	A	Arc	A	Arc	A	Arc	E	E
Dort	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Federal	Arc	Arc	A	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Mod. S-X)			A	A						
Federal (special)			Arc	Arc						
Fiat			B	A	B	A	B	A	B	A
Ford	E	E	E	E	E	E	E	E	E	E
Franklin	A	A	A	A	A	A	A	A	A	A
Grant	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
" Com'l	Arc	Arc								
" " (Model 12)	A	Arc								
Haynes	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A				
Hudson							Arc	Arc	Arc	Arc
" Super Six	A	Arc	A	Arc	A	Arc	A	A		
Hupmobile	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Kelly Springfield	A	A	A	A	A	A	A	A	A	A
Kissel									A	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A	Arc	Arc
" Commercial			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Kissel Kar	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" " (Model 48)							A	A	A	A
" " (12 cyl.)			A	A	A	A				
Lexington	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Liquid Stewart			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" " (Mod. M)					Arc	Arc	A	Arc		
" " (Mod. MS)					Arc	A				
Locomobile	A	E	A	E	E	E	E	E	E	E
McFarlan			A	Arc	A	Arc	A	Arc	A	Arc
McLaughlin	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
McLaughlin (Mod. E6)	A	A	A	A						
Madison			A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)					A	A	A	A		
Maxmon	A	A	A	A	A	A	A	A	A	Arc
Maxwell	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Mercer	A	A	A	A	A	A	A	A	A	Arc
" (22-70)									Arc	Arc
Mitchell	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
" (8 cyl.)							A	A		
Moline-Knight	B	A	B	A	A	A	B	A	A	A
Monroe			A	Arc	A	Arc	E	E	A	Arc
" (Mod. M4)			A	A	A	A				
" (Mod. 5)	A	A								
Moon			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Nash	A	Arc	A	Arc						
" (Mod. 671)			A	A						
" (Quad)	A	A	A	A						
National	Arc	Arc	Arc	Arc	Arc	Arc	A	Arc	A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
Nelson	A	A	A	A						
Oakland	A	A	A	A	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	A		
Oldsmobile (4 cyl.)	A	Arc					Arc	Arc	Arc	Arc
" (6 cyl.)	A	A	A	A	Arc	Arc			Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Overland	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Packard									A	Arc
" (12 cyl.)	A	A	A	A	A	A	A	A		
" Commercial	A	A	A	A	A	A	A	A	A	A
Paige (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (6-36)							A	Arc	A	Arc
" (6-38-39)					A	Arc				
" (6-40)	A	Arc	A	Arc						
Paige (Com'l)	Arc	Arc	Arc	Arc						
Paterson	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Peerless			Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)	A	A	A	A	A	A	A	A		
Pierce Arrow	A	A	A	A	A	A	A	A	Arc	Arc
" Com'l	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
Premier	A	A	A	A	A	A	A	Arc	A	Arc
Regal	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (8 cyl.)							A	Arc	A	Arc
Renault (Fouach)							A	Arc	A	Arc
Reo	A	Arc	A	Arc	A	Arc	A	Arc	A	Arc
Rikar	A	E	A	E	E	E				
Saxon	E	E	E	E	E	E	E	E	E	E
Selden	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (3½ ton)					A	Arc				
Simplex Crane			A	A	A	A	A	A	Arc	Arc
Stearns-Knight	B	A	B	A	A	A	B	A	B	A
Studebaker	A	Arc	A	Arc	A	Arc	A	Arc	Arc	Arc
Stutz	A	A	A	A	A	A	A	A	A	A
Velie (4 cyl.)									A	Arc
" (6 cyl.)	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (1 & 1½ ton)	Arc	Arc	Arc	Arc						
" (½ ton)	A	Arc	A	Arc						
Westcott	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
White	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc
" (Sixteen Valve)	A	A	A	A	A	A				
White (3 ton)	A	A	Arc	Arc						
Willys-Knight	B	A	B	A	A	A	B	A	B	A
Willys Six	Arc	Arc	Arc	Arc	Arc	Arc				
Winton	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc	Arc

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TRADE MARK

The Naturalist's Corner

Wild Life Conservation All Over the World

By Dr. William T. Hornaday, Director New York Zoological Society

Success with the Calico Bass.—The New Jersey Fish and Game Commission reports in its *Monthly Bulletin* that it has achieved what must be regarded as noteworthy success in breeding and rearing the calico or strawberry bass. Fifteen years ago the American Museum of Natural History pointed out the value of this northern fish for propagation in clean lakes and ponds, and urged that it should receive more attention from fish culturists. It is a fine fish for the young angler, and excellent for the table. The average size of the calico bass as it takes the hook is about one pound or less, and heretofore two pounds was regarded as its maximum limit. Now the New Jersey State Hatchery announces it has turned out specimens weighing up to five pounds. This new extreme weight gives the cultivation of this species a wholly novel aspect, and should stimulate the calico bass industry. As it is taken from the water this is a handsome fish. Its bright silver cast is beautifully mottled with olive-green blotches so regularly splashed as to suggest the pattern of a piece of calico. The species is sometimes called the grass bass.

Bolshevists Destroy a Big Preserve.—At Pilawin, in southeastern Russia, Count Potocki established and maintained a fine private game preserve of 7,000 acres. It was richly stocked with European bison, American bison, Asiatic and American wapiti, deer of many species, and choice game birds such as pheasants, grouse, black-cock and partridge. As a private game preserve it was so admirable that after having visited it, just previous to the war outbreak of 1914, Mr. Richard Lydekker wrote a book about it in order to describe it adequately. But war changes everything, and last year a section of the Trotzky Red Army reached Pilawin. The count reported in Paris a short time ago that as a result of this visitation all the wild animals of his preserve were killed, and his estate completely destroyed. There is very slight chance that even one breeding pair of European bison will be left alive anywhere in southeastern Russia, or in the forests of the Caucasus Mountains.

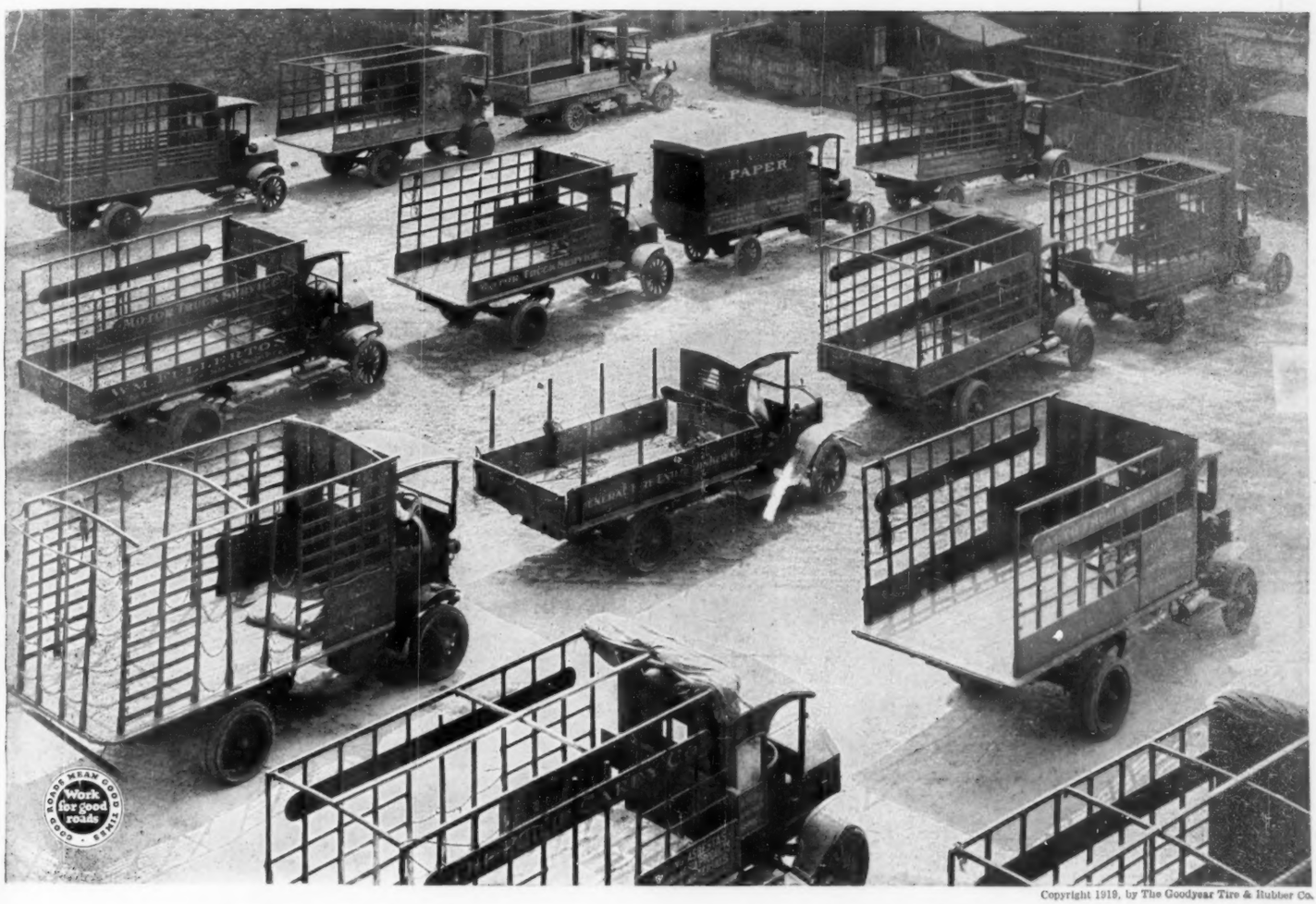
Exit Forbidden Plumage.—In 1913, after a hard fight with the millinery trade over a clause in the Wilson Tariff Bill to exclude from the United States all importations of wild-bird plumage for millinery purposes, the bird protectors won a complete victory. The clause for which they contended became a law, and forthwith all the reputable importers of bird plumage set out to obey the letter and the spirit of the law. They have steadfastly maintained that attitude and have resolutely frowned upon the attempts at smuggling and the irregularities in imports which a few dealers have attempted. Of course all the stocks of forbidden foreign plumage, such as bird of paradise, goura or crown pigeon plumes, and numidia or eared pheasant that were in the United States when the law went into effect have been legally salable, and nearly all these stocks have been disposed of. Now, however, the remnants of paradise and goura that are still on the market are getting on the nerves both of the bird lovers and the millinery importers. The former are beginning to complain about it, and very recently the Millinery Chamber of Commerce of the United States has issued to the whole millinery trade of America a strongly worded circular calling for the quick retirement of all remaining stocks of forbidden plumage, and the clearing out of these objectionable goods. Naturally this strong move will be cordially endorsed by all bird lovers.

A Living Okapi.—On August 10th, the first living captive okapi arrived in Europe, from the great rain forest of the Upper Congo. By a special dispensation of poetic justice it came to the Antwerp Zoölogical Gardens—the one most cruelly used by the war, and most in need of a great zoölogical prize. The animal is a female a year and a half old; it is in excellent health and feeding well. This is the same specimen reported in the *Zoölogical Society Bulletin* of last July by Herbert Lang, the famous zoölogical explorer of the Congo region, and collector of many fine okapi skins for the American Museum of National History. It was reared at Buta, in the Uele. It was so tame that it became thoroughly domesticated, and wandered freely and fearlessly about the post. It was planned in Buta, before the animal started for Europe, that it should be taken to Antwerp by Mr. Lebrun, an official of the Belgian Government and himself a great lover of animals. No doubt that plan was put into effect.

A FIELD of legitimate scientific interest which the SCIENTIFIC AMERICAN *has rather allowed to go by default is that represented by the above caption. We believe that an effort to tell our readers the news of the world's flora and fauna, both wild and captive, will meet support. Accordingly we have arranged to secure the material from Dr. Hornaday and others of equal prominence in other branches; and we plan to set it forth under the present head as occasion offers.*—THE EDITOR.

Loss of a Famous Wild Life Protector.—The State of Pennsylvania has lost its most active and forceful protector of wild life. On August 10th Dr. Joseph Kalbfus, for many years the fighting secretary of the State Game Commission, was killed in an automobile by a railroad train near Tiona. Dr. Kalbfus entered at the beginning, and lived through, literally with armor on and sword in hand, the stormy days of Pennsylvania's creative game-protection days. In the educating of the people into right thinking, and into the support of right laws for the protection and increase of wild life, he was a gallant and forceful propagandist and an active fighter against any opposition. It was he more than any other one man who secured the enactment of the law prohibiting aliens from owning guns—a law which the alien elements fought through all the courts until the Federal Supreme Court finally and forever affirmed its constitutionality. That law was rendered necessary by the great number of state game wardens murdered by foreign-born pot-hunters. Dr. Kalbfus was prominently active in every one of the movements and campaigns that resulted in placing Pennsylvania in the foremost ranks of the States

(Continued on page 292)



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***PREVIOUS** to five years ago we used different leading makes of solid truck tires. Since five years ago we have never used anything else but Goodyear Solid Tires. And it is our decision to use only Goodyear Solid Tires in the future. Our reasons are the same reasons that have caused many others to take the same action."—William Fullerton, Manager, William Fullerton Motor Truck Service, 3455-7 So. Morgan Street, Chicago*

CAREFULLY kept mileage records show that Goodyear Solid Tires have easily earned their places on all the wheels of the 14-truck fleet operated by the William Fullerton Motor Truck Service in Chicago.

Five years ago Goodyear Solid Tires won adoption on this busy fleet by outdistancing several other leading makes of solid tires in mileage tests conducted under regular working conditions.

And their later mileages, recorded as they have matured during the last two and one-half years, have averaged 22,062 per tire, a figure decidedly impressive in this particular type of service.

For the Fullerton trucks are hard-working trucks and the eighty Goodyear Solid Tires, required to equip them completely, must grind along all day under heavy cargoes of sheet steel, paper and other dead-weight materials while encountering car tracks, bad pavements and dangerous litter.

We talked about the eighty to Mr. Fullerton, who stated that part of the credit should go to a local Goodyear Truck Tire Service Station which made tire conservation practical despite the bad conditions frequently encountered.

So the story of the eighty Goodyear Solid Tires, and all previous Goodyear eighties, is not just a story of higher tire mileage and lower tire-mile cost but a story of tire quality and service that, combined, assure the permanency of these things.

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Attacked with Axes but still on the Job

THIS Yale Padlock was powerfully attacked with axes which cut, dented and battered it but could not break its grip.

You can buy a Yale padlock with the confidence that it will meet any test—whether it is a padlock for the garage, barn, tool house, ice house, chicken house, gates, bins, chests—or for your tire tacks or storage compartments on your automobile.

The "Yale" you buy may never have to meet the test of assault or the malicious attempt to get by. But you know that it is always on guard, sturdy and unyielding, ready to meet the test when it does come.

Correct construction, in both materials and design, assure the reliability and endurance of Yale padlocks and of every other lock bearing the trade-mark "Yale". "Yale" will not fail to protect.

Go to your hardware dealer for the Yale padlocks you need. You can make sure of SEEING the trade-mark "Yale" on each one. It is always on Yale products—on Yale Night Latches, Door Closers, Builders' Locks and Hardware, Cabinet Locks, Bank Locks and Chain Block.

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The Yale Cylinder Night Latch is another Yale Product equally capable of withstanding malicious attack.

Use Yale Cylinder Night Latches to back up and reinforce doubtful door locks that already are in service around your house.

Williams' "Vulcan" Drop-Forged Safety Lathe Dogs

We dislike to use superlatives in describing our product; we prefer to put the superlative into the work. We *must*, to maintain a reputation that has, for nearly half a century, stood for "Superior" Drop Forgings. And that reputation stands solidly back of our "Vulcan" Safety Lathe Dogs.

Bent and Straight Tail patterns, 16 sizes, 3/8" to 6" capacities. Also made with two screws for extra heavy service.

Write for Machinists' Tools Booklet.

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The Naturalists' Corner

(*Continued from page 290*)

distinguished for their wise and far-reaching laws in protection and increase of wild life. His place in the history of wild-life protection in America is a high one, and one forever secure.

Saving the Yellowstone Elk.—The fate of the Yellowstone Park elk herds, now by some persons said to be seriously diminishing, has developed into a serious problem, with about as many points of view as a polyscope. After many months of study and investigation on the ground in the Jackson Hole Country, the United States Forest Service has evolved a plan and submitted it to the public in print. It calls for rather large expenditures on the part of the Federal Government, in purchasing additional lands to serve as winter feeding grounds for the elk herds that spend the summer in the park, and which at the approach of winter march southward through the snow to the only spot where they ever found food available in the cold season. But in the Jackson Valley the best elk feeding grounds are occupied by ranches. For several years the Government has been buying hay from ranchmen, and hauling in hay from outside, to feed the hungry elk herds. But this method of elk salvage is temporary and inadequate and something else must be done. Mr. Emerson Hough in a bitter article has attacked the Government's facts and plans. The cattle men, or at least some of them, are bitter and unconvinced. They are opposing the proposed Mondell extension to the Yellowstone Park, and assert that it would not be of any value whatever in saving the elk situation. Many conservators of wild life are in a state of watchful waiting, not knowing just at present what to think.

Gift of Wild Animals to Belgium.—While the Huns were still in Belgium, the New York Zoölogical Society, by a roundabout means, informed the Royal Zoölogical Society of Antwerp that just as soon as the soil of Belgium had been freed of the invader it would make to the Antwerp zoo a large gift of animals as a contribution to its renaissance. On account of the heavy losses suffered the Antwerp Society has not been able to accept the gift before the present time. Now, however, the city of Antwerp has made a large contribution toward the restoration of the half-ruined cages and buildings, and the gift can be received immediately. For three weeks Director Hornady and the curators at the Zoölogical Park have been preparing for shipment a really huge assemblage of live mammals, birds, reptiles and amphibians. All these specimens are either duplicates born and reared in the park, or else are specimens specially purchased by the Zoölogical Society for the gift to Belgium. While complete lists are not yet available, it is known that the lot will contain bison, yak, Barbary mountain sheep, tapir, deer, elk, zebra, wild horse, bear, kangaroo, wolves, foxes, sea lions, and many smaller mammals. The bird collection will comprise representatives of 104 species, in about 350 specimens, including such large forms as the ostrich and emu. This great gift will be transported by the Lloyd Royal Belgium Line, and will leave New York about October 1st, in charge of three very competent Zoölogical Park keepers.

Deer Hunting in the Adirondacks.—Unless by proclamation of Governor Smith all fall hunting is forbidden on account of the great danger of destructive forest fires, the coming six weeks' deer-hunting season will see in the Adirondacks a new procedure. Goaded by the lawless elements of that region into signing a doe-killing bill, to determine by one experimental season how the plan clamored for by the doe-killers will work out, the Governor has given the killers of female deer a chance to shoot mother deer, and also to shoot one another. But it must not be supposed for a moment that the Governor believes in the "ethics" of killing breeding female deer. Quite the contrary. On account of the outrageous and shameless lawlessness recently prevailing in the Adirondacks, he said: "We must try the other plan for one season, and see how it works." That there will be a considerable number of hunters killed by deer-hunters is reasonably certain. It is so in every densely populated State wherein any deer may be shot regardless of sex. The absence of a buck law leads the nervous or the green amateur hunter to shoot at moving bushes in order not to miss his chance; and in one year in Wisconsin, previous to the buck law, 27 dead hunters were counted as the result. The fighters of the demand for doe-killing now warn all parents whose sons contemplate hunting deer in the Adirondacks this year that the risks of being killed are now very great. Adult hunters who know what doe-killing means are left to take care of themselves, and pass the increased risks along to the life insurance companies.

The See-Saw Concrete Mixer

(*Continued from page 279*)

direct means of handling than the hoe. But he recognizes that a good deal of assistance can be given the man with the hoe, without altering the fundamental character of the treatment given the material. In particular, he finds it burdensome to demand that the hoer generate all the power for moving the heavy mixture from one end of the mixing tray and back again. So he has fixed up his mixer in such a way that this little detail is largely attended to by gravity.

Everybody who has ever worked over a batch of concrete with a hoe must have thought how much easier his job would be if the tray were only tilted, so that he could hoe down from the upper end to the lower. But then comes the distressing thought of what will happen when the mix has been brought entirely to the lowest level. Shall we turn about and proceed to sacrifice all the advantage gained, by hoeing it back up-hill?

The inventor of the see-saw mixer has answered this question the way we should like to have it answered. He has given us a mixer tray mounted on a rocker. Then, when we have hoed the mix all the way down from the top of the tray to the bottom, all we need to do is to reverse the tray and hoe it down from top to bottom again—and again and again, until mixing is complete. We are not even asked to tilt the tray over by unaided elbow-grease; it is semi-suspended from a tackle, with its roller resting on the ground, in such a way that we haul it over by pulling on the rope. Also, it is divided into compartments by transversal baffleplates, so that we get the extreme of mixing action possible as we hoe the mix over one after another of these.

As compared with shovel mixing on a floor, the inventor states that the see-saw mixer saves one man's wages and several bags of cement each day. There is no stooping—a very big factor—and no wet feet on a wet floor. The use of the muscles is diversified and changed, so that instead of just one stooping movement all day, there are three separate operations; yet this change in the work does not cause any loss of time. Like a wheelbarrow, the see-saw mixer is just a simple little device to enable a man to do more work in a given time, with less fatigue.

High-Lights of Air-Travel

(*Continued from page 280*)

as well as increasing it by reflection. From the viewpoint of visibility the haze is generally more annoying to the observer at altitudes of about a mile than

(*Continued on page 294*)

TORBENSEN INTERNAL GEAR TRUCK DRIVE

Driving at the Wheel and near the Rim

It is an elemental rule of engineering to apply power at the wheel and near the rim.

Because Torbensen Drive obeys this rule, it delivers great power to rear wheels—a tugging power which is best demonstrated in hard going and on hills with heavy loads.

Engine power is utilized to the fullest extent with resultant saving of gas and oil.

That Torbensen efficiency is generally recognized is proved by the fact that more Torbensens are in service than any other type of truck rear axle.

POWRLOK
"More than a differential"
Prevents stalling or skidding provided either rear wheel has traction

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Makers of Front and Rear Truck Axles

Largest Builder in the World of Rear Axles for Motor Trucks

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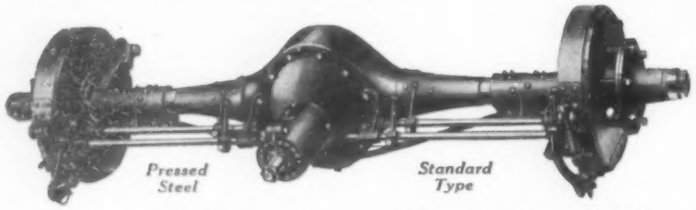
The Salisbury New Rear Axle



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YOU may have the best engine in the world in your car but that does not and cannot make a *good motor car* unless the *rear axle* is mechanically correct and physically perfect.

The superiority of the Salisbury New Rear Axle is due to the fact that its mechanism is compact, silent and combines the great strength of our own special formulae steel with simplicity of design and construction.

The reason that the Salisbury New Rear axle transmits the power of the engine to the driving wheels with the least possible friction or loss of power is because more than 150 of its parts are carefully machined and fitted to micrometer measure.

Made in two standard sizes for cars weighing from 2600 to 4000 lbs.

The Automobile manufacturer who specifies our axles adds a strong selling point to the prospective purchaser.

Established 1902

Salisbury Axle Company

Jamestown, N. Y. U. S. A.

High-Lights of Air-Travel

(Continued from page 292)

at very high altitudes because at the lower altitudes the observer in attempting to penetrate distance looks through a greater length of haze than is the case at high altitudes. A yellowish filter is generally best suited for eliminating or reducing the haze effect in photography.

The aerial traveller may divide the commoner clouds into two groups—low ones and high ones. He is generally among or above the low ones but ordinarily he will not reach the region of the high clouds. The international classification of clouds, of course, divides them more elaborately, but generally the cirrus clouds and their relatives are above 25,000 feet and the common cumulus clouds are below 6,000 feet. During storms and uncommon conditions tremendous thunderheads and cloud-mountains rear themselves up into the high cloud region. The clouds are the overwhelming wonders of the aerial world. They make it a fairyland indeed, and provide much to interest and move the observer. But this article makes no pretense toward doing justice to the poetry of air travel. The brightness of the upper sunlit surfaces of clouds varies with their density or depth. When very deep or dense their reflection factors are as high as eighty per cent; that is, they are as bright as pure deep snow or fairly white pigments. As one sails over a cloud bank on a sunny day he should look for his shadow on the clouds. It will be well-defined, with a beautiful aureole of spectral colors caused by diffraction of light. This is one of the rare opportunities for witnessing this phenomenon.

The aerial traveler will find his interest in clouds very much stimulated. Their varying forms, their altitudes, their birth, and their disappearance, all provide many interesting details for study far too extensive for treatment here. The relation to weather forecasting is especially of interest in air travel. The feathery cirrus clouds of ice particles are usually the harbingers of a storm. The clouds obey the winds and therefore reveal something of these invisible currents. Cirrus clouds are born in the cradle of a storm by vapor-laden air sent upward to great heights. These clouds are caught in the path of extremely high winds and sent forth much more rapidly than the storm center which is at a lower altitude. Thus they become the advance agents of the storm with as much certainty as possible in the erratic world of meteorology. When it is considered that clouds vary in thickness from the filmy feathery cirrus to the towering cumulus five or six miles in depth and are molded and whipped into an infinite variety of shapes, it is obvious that the clouds are of perpetual interest.

In closing this article whose aim is chiefly to open the eyes of the aerial traveler (whether he travels in his imagination or in reality) it appears appropriate to discuss briefly the range of vision. In many respects air-travel has opened new avenues of experiences. One of these is the greatly increased range of vision. Some of us have looked from the top of a mountain range and recognized another range more than one hundred miles away. However, seldom is the opportunity to be had to see clearly for this distance. The range of vision increases with the square root of the altitude. At an altitude of four miles the range of vision on a clear, cloudless day is approximately two hundred miles. Very clear days are not uncommon in some parts of this country and they are doubtless encountered occasionally nearly everywhere. This greatly expanded range of vision is sometimes very awesome, for on an extremely clear day there are few states that cannot be seen completely with one sweeping view from a position four miles in the air over the center of the state. Rising to such an altitude over the central part of Iowa and seeing the details of the Mississippi and Missouri Rivers at one time is almost inconceivable until it has been done. Viewing the various great rivers of Virginia and all the details of Chesapeake Bay and the Virginia Capes at one sweeping glance has been done by aerial travelers. The extent of the range of vision is especially emphasized in viewing one of Nature's most wonderful spectacles—a storm—as only a single scene in a tremendous panorama.

These are a few of the high-lights of air-travel. There are many variations of these and the aerial traveler finds his time fully occupied in this new wonderland if he possesses eyes that see. If he also possesses a responsive imagination he is doubly blessed, for the mastery of the air has opened to him a wonderland.

Secrets of Antiquity

(Continued from page 282)

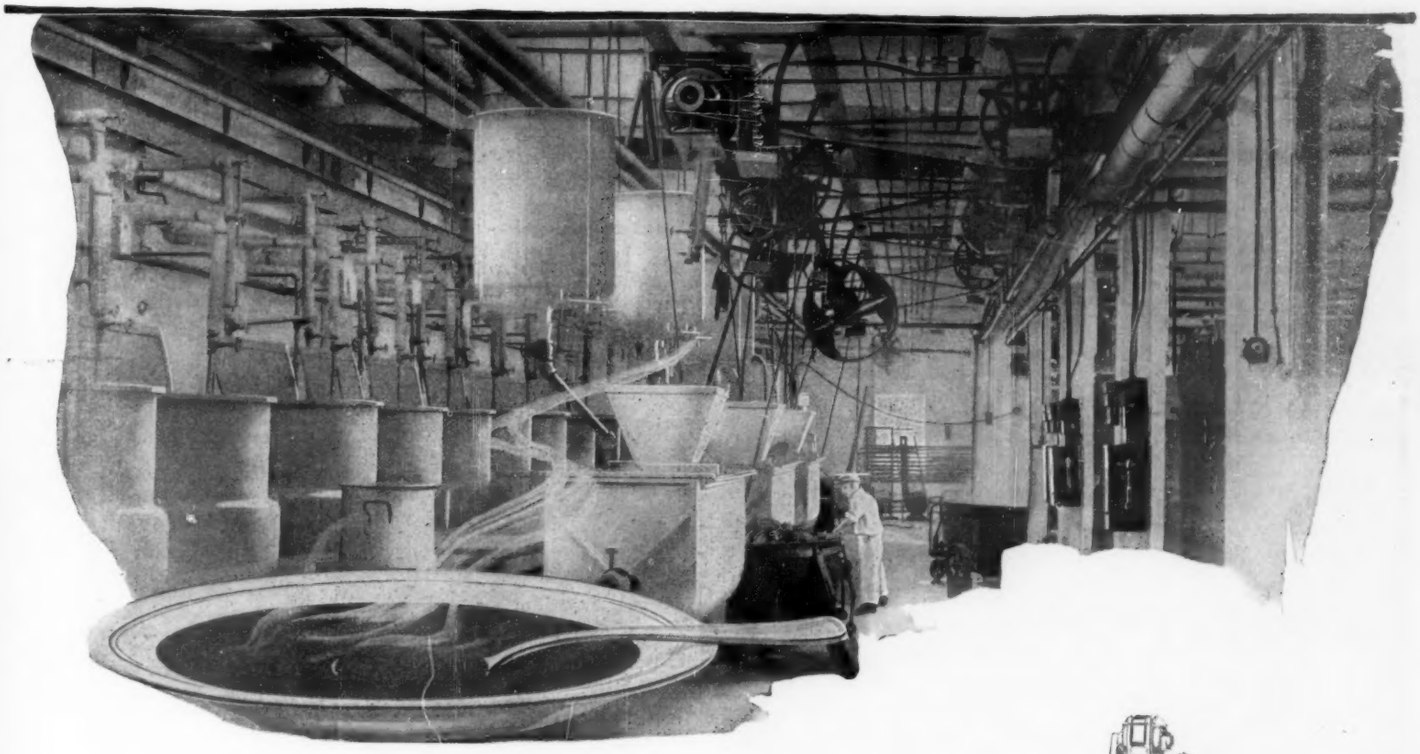
The new bronze has amply proved its serviceable qualities in the frictional parts of machinery of all kinds. Trolley wheels made of it have run 30,000 miles, and have then shown but very little wear of the groove. The endurance of the ordinary composition trolley wheel is rated at 5,000 miles. Because of its extreme fluidity when melted, this metal makes it possible faithfully to reproduce the most delicately wrought designs. Advantage has been taken of this to mold "hubs" for die sinkers. Ordinarily, the hub is made of fine steel, and the design is cut into the metal by hand or, at least, finished by hand—a decidedly expensive procedure. A bronze cast hub eliminates much of this costly labor, and is found to be sturdy enough to withstand the blows of a hammer when the steel is heated to the ordinary point of softness required in sinking a die. That is to say the bronze hub can be driven into the then relatively plastic steel without being, itself, injured.

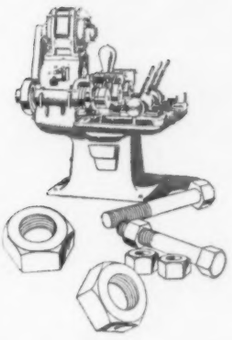
Because the metal is not subject to electrolytic attack, it seems quite likely that it should prove peculiarly valuable for turbine blades and for the propellers of seagoing vessels. Today, one of the most serious difficulties in turbine installations is the wearing away of great numbers of the tiny blades in the presence of high-pressure steam; and many experts are of the opinion that this destructive action is of an electrolytic nature.

Bells made of the new bronze are noted for the clearness and the sweetness of their tone; and the sound has a very marked carrying quality—being decidedly superior in this respect to bells of any other metal and of the same weight or dimensions. It is therefore not surprising that phonograph needles of this material have distinctive virtues, not only in the matter of durability, but in the manner in which they reproduce faithfully every shade of the tones of the original song, instrumental selection, etc.

Bronze hairsprings for watches have been in use now for over a year, and have demonstrated that they are of exceptional sensitiveness. In two particulars they are distinctly superior to steel, because they are non-magnetic and rustproof. For certain kinds of cutlery, especially where a "soft" or exquisitely sharp edge is desired, the new bronze is of outstanding value. The metal, however, while taking a smoother edge than steel will not hold it as long as the latter, because the bronze is not so robust. Even so, there are some rugged uses to which bronze cutlery lends itself better than similar articles of steel—notably where they are to be frequently sterilized or where moisture is commonly contended with.

(Continued on page 296)





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THE steaming plate of Campbell's Soup on your table, your Victrola, and many commonplace utilities such as bolts and nuts come from Camden, N. J. They are produced by electric power applied to absolutely unlike processes of manufacture.

There are dozens of other industries in Camden, quite as dissimilar — in which electric power is the dependable, economical driving force. They include ship yards, glass, wood-working and chemical plants, textile and paper mills, farm implement factories and machine shops.

These industries are dependably assisted by the G-E Motor Agency in Camden, which renders engineering, construction and maintenance service of high order.

For example, a Camden rope mill saved $29,000 in a single year's production as the result of a $30,000 installation of electric power applied by the local G-E Motor Agency.

G-E Motor Agencies throughout the country exist primarily to serve their local industries in all questions involving power application. The experience and engineering resources of the General Electric Company are at their command.

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Simonds Quality—
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From the selection of the raw metal throughout every process and test to the finished product Simonds quality dominates.
And results fully justify Simonds thoroughness. In millions of hands and machines Simonds Saws are daily cutting the cost of cutting by saving time, labor, and power in the working of wood or metal.
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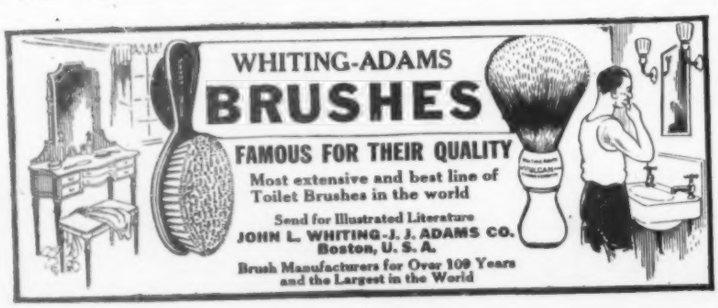
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JOHN L. WHITING-J. J. ADAMS CO.
Boston, U. S. A.
Brush Manufacturers for Over 100 Years and the Largest in the World

Secrets of Antiquity

(Continued from page 294)

The cost of the secret ingredient, which distinguishes the Dawson metal from other bronzes, is small, and the stuff can be had in abundance. Curiously, there is no slag or oxide when the metal is melted, and once the "dope" is added the bronze retains its acquired virtues indefinitely.

Our Technical Achievements in the Great War

(Continued from page 284)

dents, etc., are very much larger, since some armies lost more heavily from disease and privation than from battle. It is our opinion that the total deaths from all causes in battle and out of battle must have exceeded 10,000,000 men.

The table given, and all other diagrams in this chapter and in the previous chapters of this series, were compiled by the Statistical Branch of the General Staff of the United States Army, and, commenting on these tragic figures the report says: "The table shows that Russia had the heaviest losses, in spite of the fact that she withdrew from the war after the fall of 1917. American losses are third from the bottom of the list. German losses were 32 times as great as the losses of the United States; French 28 times and the British 18 times as much."

That the American losses were not more severe was due to the fact that our armies were in heavy fighting only for 200 days. Referring to the diagram showing the number of deaths which occurred each week during 1918, it should be noted that the first rise in the columns, in the last part of May, reflects the battle of Cantigny. The second rise, in July, reflects the heavy losses when American divisions were thrown in along the Marne salient, when the Allied offensive began. The heaviest losses of all were in the Meuse-Argonne drive, lasting from the end of September until November 11.

Battle Deaths in the Various Services

The diagram showing battle deaths in each service is extremely interesting. It reveals that the chances of death are much heavier in the Infantry than in any other branch of the service. Of each 1,000 enlisted men in the Infantry, 46 were killed in action or died of wounds, and the officers showed an even higher rate, thereby confuting the foul slander which has frequently been put forth that the officers did not expose themselves in leading their men. The discrepancy in death between officers and men in the Air Service is due to the fact that in our Air Service all aviators are officers.

Wounded, Prisoners, and Missing

For every man who was killed in battle, seven were wounded, taken prisoners or reported missing, as shown in the accompanying table of total battle casualties:

Killed in action	34,180
Died of wounds	14,729
Total dead	48,909
Wounded severely	80,130
Wounded slightly	110,544
Wounded, degree undetermined	39,400
Total wounded	230,074
Missing in action	2,913
Taken prisoner	4,434
Grand total	286,330

The number of men reported as missing has been steadily reduced from 22,724 exclusive of prisoners, to 2,913. Only 22% of those who were originally reported as missing in action have now been reported as dead. The accompanying comparison by sectors of circles shows the result of clearing up the records of more than 19,000 cases reported as missing. The largest number of these was found in hospitals, while a considerable number returned to duty after being lost from their units. When the records are finally completed, there will be very few American soldiers unaccounted for.

Comparison of Battle and Disease Losses

The total deaths in both Army and Navy from our declaration of war up to May 1, 1919 was 122,500 of which 112,432 occurred in the Army and the Marines which were attached to the Army. Two-thirds of these deaths occurred overseas. Almost exactly one-half of these losses were from disease. If the comparison between disease and battle losses is limited to the Expeditionary Forces, battle losses appear more than twice as large as deaths from disease.

This is the first war in which the United States has been engaged that showed a lower death rate from disease than from battle. In the diagrams showing a comparison of disease and battle deaths, the figures used are the number of deaths each year among each 1,000 troops. In previous wars unsanitary conditions at camps and the ravages of epidemic diseases have resulted in disease deaths far in excess of the number killed on the battlefield. The death rate from disease in the Mexican war was 110 per year in each 1,000 men; in the Civil War this was reduced to 65; in the Spanish-American War to 26; while the rate of the Expeditionary Forces in this war was only 19.

The Control of Disease

The conditions which led to the remarkably low disease rate in the war against Germany are:

(1) A highly trained medical personnel; (2) compulsory vaccination of the entire army against typhoid fever; (3) thorough camp sanitation and control of drinking water; (4) adequate provision of hospital facilities.

At the beginning of the war there were 2,089 commissioned medical officers, including the "Reserves." So splendid was the response to the call that 31,251 physicians from civil life were commissioned in the medical corps.

The intestinal diseases, such as dysentary, the typhoids, bubonic plague, cholera, and typhus have ravaged and even obliterated armies in the past. Thus during the Spanish-American war typhoid fever alone caused 85% of the total number of deaths; but in the war with Germany these diseases were practically eliminated as causes of deaths. During the entire war up to May 1, 1919, a total of only 2,328 cases of typhoid fever have been reported and only 227 deaths occurred from this cause.

Our diagram showing the relative proportion of deaths caused by the principal diseases shows that pneumonia has been the greatest cause of death, for over 40,000 died of the disease. Of these probably 25,000 resulted from the influenza-pneumonia pandemic which swept through every camp and cantonment in this country. The explosive character of the epidemic is evident in our diagram showing deaths per 1,000 soldiers each week in the United States. The curve starts to rise sharply during the third week of September. It reached its high point the second week in October when four out of each 1,000 troops under arms in this country died. Meningitis and tuberculosis, both of them contagious diseases, were largely the result of bringing numbers of men together in the confinement of camps and cantonments where the control of contagion is difficult. Great success was experienced in the control of the venereal diseases. A comprehensive program of education, together with medical prophylaxis produced unusual results. Of 48,167 cases treated at five large cantonments, 96 per cent were con-

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tracted before entering the army, and only 4 per cent after.

The Provision of Hospitals

At the beginning of the war, what was considered an extravagant program of hospital construction was entered upon, with the intent that in no case should the army lack facilities to care for its sick. On December 1, 1919, there were available in army hospitals, 399,510 beds, or one bed to every nine men. Of these beds 287,290 were overseas and 112,220 beds were in this country.

One of our diagrams shows the number of patients at the end of each week in the American Expeditionary Forces, compared with the beds available. The hospital capacity was exceeded in this country only during the influenza epidemic and that was for a comparatively short time when it became necessary to take over barracks for hospital purposes. The overseas record was even better. Except during two weeks in October at the height of the attack on the Hindenburg line, the number of patients did not exceed the normal bed capacity of the hospitals, and at that time there were approximately 60,000 unused emergency beds.

Making the Desert Bloom in Australia

(*Continued from page 285*)

plement the natural flow from the remaining 3,000 square miles of the Murrumbidgee catchment, which is contributed by the important affluent, the Tumut River, joining the Murrumbidgee between Burrinjuck and Gundagai.

The water stored behind the Burrinjuck dam is passed through sluices into the Murrumbidgee River, and this water, together with the unregulated flow of the remainder of the catchment, flows down the Murrumbidgee until a portion is diverted from the channel at the Berembed diversion weir, a distance of 220 miles down stream from the Burrinjuck storage site. From Berembed, the irrigation supplies are conducted by an open channel past the town of Narrandera, skirting the foothills of the MacPherson Range, and distributed by a network of laterals for the irrigation of the lands extending in a westerly direction.

The irrigation areas have direct railway communication with Sydney and Melbourne and with the principal States of Australia. The railways are owned and controlled by the State, and carry settlers' produce at low rates. They give direct access to every important part of the State and the seaboard.

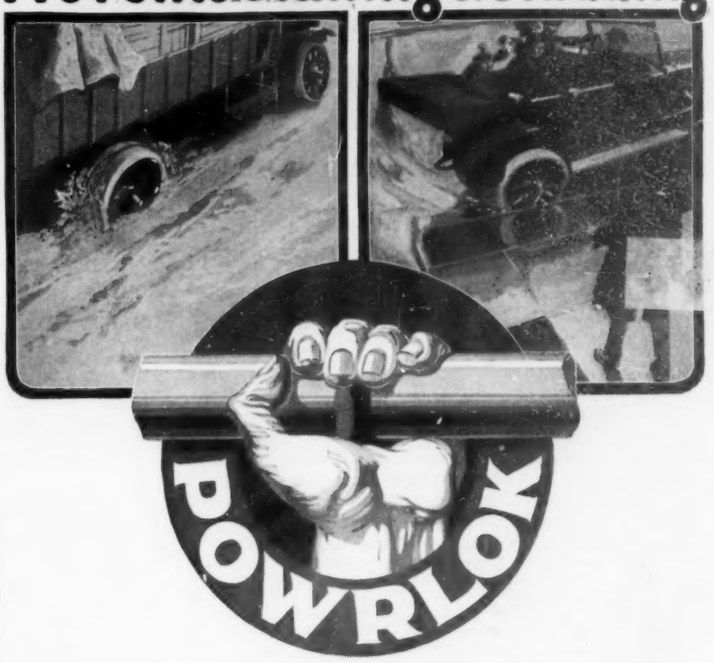
The forms of assistance which it is the policy to grant to settlers on the Murrumbidgee Irrigation Area are alike practical and liberal. The continuation of this policy from year to year is subject to Parliament making funds available.

To assist the settler in the early stages of development, the Commission is prepared to suspend up to four years the payment of any sum due, and allow such sum, with 5 per cent interest added, to be repaid within a period not exceeding sixteen years, reckoned from the date on which such terms of repayment are granted. This concession is subject to the farm and the settler's interest in the improvements offering sufficient security.

Advances in money, or the equivalent in building material, fencing wire, wire netting, fencing posts, grading work, fruit trees, or lucerne seed, are made to settlers on the security which the farm and improvements already owned by the settler, offer at the time of application. The advances are repayable over a period of sixteen years with 5 per cent interest added.

As security for any suspension or advance, the settler is required to give a mortgage over his farm, the fees in connection therewith being three pounds three shillings, to cover costs of inspection, registration fees and legal expenses.

Prevents Stalling & Skidding



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A Real Hotel on Wheels

(Continued from page 287)

clothing. At the rear of the body is a complete kitchen equipment.

The rear is also equipped with a motorcycle used as a tender and may be employed for special errands that may take the driver of the truck off the main line of travel. A complete standard lighting system which furnishes twenty-five electric lights is utilized with batteries, generator and motor. Compartments on the outside of the truck contain tools, ropes and various other items of equipment that is likely to be needed. The truck is equipped with water tanks and pumps and modern sanitary plumbing. It rides on very large pneumatic tires. A large tent fly can be stretched from the top of the truck to a distance ten or fifteen feet away.

The driver sleeps on a specially devised seat which can be turned into a bunk at night. This unique body is mounted on a 2-ton truck chassis, the frame having been lengthened to meet the body requirements and equipped with shock absorbers. Touring in this way permits the tourist to get off the main line of travel and visit at will any spots that may occur to him and be entirely free from dependency upon hotels or railroads. The car is the property of the executive of a prominent automobile manufacturing company. The use of pneumatic tires not only makes the vehicle more comfortable but gives it greater speed and permits of maximum fuel economy.

Features of the Still Engine

AT the British Royal Society of Arts, recently, Captain F. E. D. Acland introduced the "Still" engine to the technical world. This engine is the invention of W. J. Still, who apparently is an even more than usually modest and retiring inventor. It has been known in engineering circles for some time that Mr. Still, with the assistance of others, had been working for years on the problem of improving the efficiency of the gas and other internal-combustion engines, and had reached a certain measure of success. For reasons which were doubtless sufficient, it was considered necessary to suppress all public reference to Mr. Still's invention during the war; hence the recent somewhat belated announcement of what has been so far achieved. In the gas and oil engine, as in the steam engine, by far the larger proportion of the heat introduced into the working cylinder is rejected and wasted; the proportion of that heat which does really useful work being rarely more than 15 per cent in the steam engine, while 34 per cent is about the highest ratio claimed for the Diesel engine, and 25 per cent for suction gas engine. Mr. Still's object is to utilize some of the heat of a gas or oil engine which is thus in ordinary practice thrown away, and he does so by using it to raise steam in a steam boiler and then using the steam to assist the gas or oil engine to do its work.

The idea is not new; there are very few really new ideas. As Sir Dugald Clerk reminded the meeting, an inventor in the Midlands, more than thirty years ago, raised steam with the waste heat of a gas engine, and employed the steam to work the engine. Unfortunately, gas-engine construction had not advanced very far in those days, hence that inventor had to introduce the steam into the same cylinder where the explosion took place, and while he secured some little advantage, the greater part of the possible gain was neutralized by the fact that the steam cooled the primary working medium. Again, it has been proposed to use steam generated by the gases of a gas or oil engine in a separate steam engine working on ordinary lines, and this is actually done at this moment. Mr. Still avoids the mistake of the Midlands inventor, and also escapes from the necessity of a separate engine by using his auxiliary steam on one side of the piston of an engine while the explosive agent is used on the other. It would appear possible that the efficiency of a gas engine may be in this way ultimately doubled, and certain that it may be very largely increased. A larger engine may be needed for a given power, but the economy which would result from the adoption of this system would represent a very appreciable proportion of the national power bill. Mr. Still's invention may not be comparable with that of the Parsons steam turbine or the Diesel engine, but it is highly probable that it will represent an important stage in the history of heat engines.

Liquid Oxygen

SPEAKING at a recent meeting of the Royal Institution in London, Sir J. Dewar referred to the disappearance of the barium oxide process of manufacturing oxygen, and its replacement by that involving the fractionation of liquid air. For a time there was no demand for the nitrogen thus liberated, but soon it found extensive application in the manufacture of nitric acids and nitrates of cyanamide, and of ammonia by the Haber process. The German dye manufacturers had exploited the electrical method of fixation and had invested a large sum in acquiring cheap water-power in Sweden. So much importance was attached to the Haber process in Germany that it had been made a national monopoly, and, in effect, it had been the principal means of enabling that country to satisfy its requirements of explosives during the war. For the Haber process the hydrogen was obtained electrolytically and by freeing water gas from admixed gases with the aid of low temperatures. In England the total output of the 12 factories manufacturing liquid oxygen was 1 million cubic feet, say 118 tons, per day, 85 per cent of which was used for cutting and welding metals and 15 per cent for medical purposes. In Germany one plant alone was producing 100 tons per day.

Liquid oxygen has been much used by airmen flying at high altitudes. For this purpose it is stored in vacuum vessels provided with a mechanism for controlling the evaporation, and with tubes leading to a mouthpiece through which the aviator may inhale. There are three types of mechanism. In the first, the liquid is heated electrically; in the second, the evaporation is promoted and controlled by thermal conduction through a rod of copper or aluminum in the liquefied gas; in the third the liquid is siphoned out into an evaporating chamber, from which the gas is conducted through tubes—to bring it to air-temperature—to the airman's mouth, the rate of evaporation being controlled by adjusting the conical stopcock through which the gas is passed.

Liquid air is stored in spherical metallic vacuum vessels holding from 5 to 30 gallons, the high vacuum required being maintained by keeping absorbent charcoal, cooled to the temperature of the liquefied gas, in a chamber attached to the lowest part of the external wall of the inner vessel, whereby the annular space is highly exhausted. These vessels are durable, and the rate of loss from the largest does not exceed 5 per cent per day.

The lecture was illustrated by numerous experiments, among the most remarkable of which were the demonstration of the magnetic property of liquid oxygen by placing an electro-magnet near drops of it falling from a pipette, these being drawn to the pole in the form of a thin stream; and the stopping of the motion of a radiometer wheel by creating a vacuum around it with liquid air and charcoal, the pressure being reduced to about 1/50 millionth of an atmosphere.

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Metallic Lifebuoys for Use at Sea

METALLIC lifebuoys made by a British firm are a recent novelty and are described as follows. They are made of 24-gage or 16 ounces copper with a die, and stamped out of the sheet in two sections, "he and she." The joints, one on the outside and the other on the inside edge, are formed by fitting the one section into the other and clinching and brazing them together. The lifebuoys are proof against the effects of weather, climate, and sea water, and they have ample strength to resist puncture or abrasion. In comparison with the regulation cork buoy weighing 13½ pounds they weigh, with hemp cord, 10½ pounds, and in comparative tests in fresh water, while a cork buoy supported 36¼ pounds and sank after 36 hours' immersion, its weight being then 17½ pounds, the metallic buoy supported 42 pounds and weighed the same as when it was put in, being capable of immersion for an indefinite period without loss of buoyancy.

Bulk for bulk the metallic buoys weigh less than three-quarters of the canvas and cork form even when it is new and dry, and they retain their buoyancy unimpaired, whereas that of the latter is gradually reduced by painting and exposure.

The reversible pontoon life-raft made by another British firm consists of a timber framework, side and end planks and close deck planking, the requisite buoyancy being obtained by eight copper or Muntzmetal tanks fitted between the timber frames. Its weight is about 14 hundredweight, the Board of Trade limit being 15 hundredweight, and it has a net deck area of 72 square feet, providing, on the Board of Trade basis of 4 square feet per unit, accommodation for 18 persons. Receptacles for water, provisions, and other equipment required are provided, mostly in the body of the raft.

Paste Which Preserves Watermelons

COMMERCIAL chemistry, applied to the watermelon, plays a big part in delivering to the Northern consumer, hundreds, perhaps thousands of miles from the producing district, reasonably-priced melons which are crisp, fresh, and just ripe enough for maximum enjoyment. The chemistry involved is a special paste which is applied to the stem end of the watermelon by the shipper. This paste furnishes complete protection to the stem end, a point where otherwise decay is very likely to set in. Before this paste was originated, the loss of entire cars of watermelons from decay was not infrequent.

So necessary and valuable is the paste, that a regional director of railways this season issued an order that unless melons were pasted they would not be accepted for transmission except by prepaid freight. The regional director stipulated that shippers use a paste recommended by F. C. Meiss, of the United States Department of Agriculture.

One of the good things about this watermelon paste which accomplishes such important results is that it is inexpensive. One quart of paste will treat an entire carload of watermelons. In order that the paste will not disfigure the melons, it is prepared with green coloring matter, pistachio being used.

Using copper or enamel-ware vessels, the watermelon shipper dissolves four ounces bluestone in two pints boiling water, and three ounces powdered alum in one pint water, adding to the latter 4½ ounces rye flour and mixing to a smooth paste. When the bluestone is thoroughly dissolved, he pours the solution into the paste, stirring the mixture thoroughly. It is now brought to the boiling point and cooked for five minutes, then cooled and strained through cheese-cloth. Last of all, before placing in glass jars or tin cans lined with paraffin, sealed air-tight, the paste is colored with one-half fluid ounce of pistachio green.

During the war, cost was secondary to speed in production, but now manufacturers must give their most minute attention to keeping down expense. In power transmission it is less wasteful to use belting that may be relied upon for long service. The cost man recommends

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because its long wear more than outweighs its first cost. Made in a plant where skill and integrity have produced leather belts of the highest quality for generations, it can be depended upon for durability.

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BASLINE AUTOWLINE, is a smaller edition, for use on passenger cars. Has patented Snaffle Hooks. At dealers, $5.80 east of Rockies.

POWERSTEEL AUTOWLOCK, a safeguard against stealing of car or spare tire, has strong lock that can't be picked. At dealers, $2.35 east of Rockies.

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POWERSTEEL TRUCKLINE

Latest Patent Decisions

Equivalence of Means:—This is an infringement suit on a patent issued to R. E. Brown and E. C. Gaines for a rail clamp for travelling bridges. The chief question is one of equivalence, as the validity of the patent is not contested, though it is contended that its scope is greatly narrowed by the prior art.

Travelling bridges are used on coal docks to load and unload boats and cars running back and forth on railway tracks to place the loading apparatus in proper position. The bridges vary in height, some being upwards of 100 feet, and, being built often on the Great Lakes, are exposed to windstorms. The patent apparatus is designed to hold the bridge securely on the rails whenever not in use, or when a severe wind is anticipated.

In the electric wiring of the respective devices of plaintiff and defendant herein there is no great difference. In plaintiff's the weight is sustained by the motor running as a dynamo to create enough E.M.F. to sustain the weight in its elevated position. For this defendant substitutes a solenoid energized by the current on the line to apply a brake to the weight drum and thus holding the weight.

The substitution of mechanical means for electrical by using a solenoid instead of a motor or dynamo to hold up the weight or to regulate its fall, is simply an equivalent or identical means and operation. But there is a substantial difference between the means and operation for applying the clamps. Plaintiff's invention should be given its full scope, but without allowing protection to different machines producing the same result.

Finding no infringement the bill should be dismissed, holding, as a point of law, that, though a patent is of a primary character, entitled to liberal treatment, it is not infringed if defendant's machine lacks the identity of means and identity of operation, which must be combined with identity of result to constitute infringement of a combination claim.—*Heyl & Patterson Co. v. M. A. Hana Coal & Dock Co. U. S. D. C. of Wis.*

The Prior Art:—Appellant's suit is on the Stuckart patent, for a sharpening device on meat slicing machines. In the standard machine, a rotary steel disk is the slicer. The concave side terminates in the flat face of the cutting edge—the convex side in the bevel face. The bevel face requires more grinding, as the flat face should be kept flat. On the flat face nothing is required but grinding away the burr or wire edge caused by grinding the bevel.

Appellee's sharpener, like those of the prior art, has two grinders on one support. When the lever is in one of its locked positions, the grinders are held away from the knife. When the lever is in the other locked position, the grinders come into contact with the two faces simultaneously. On the bevel side a strong spring gives hard grinding, and on the flat side a weak spring gives light grinding, but both at the same time. Thus used, appellee's device does not infringe.

Appellee's sharpener is that of the prior art. Probably no sharpener of that type ever could be built in which the two grinders would touch the sides of the knife with exact mathematical simultaneity. So every owner of an old sharpener will be found guilty of infringement on proof that in use the one grinder bore against the double face before the other touched the flat face. The claim cannot be allowed to have that grasp. "Successive," in Stuckart's combination, must be held to apply to those movements of the two grinders that are separate and independent of each other in time and place. *United States Slicing Machine Co. v. Wolf, Sayer & Heller, Inc., appealed from the District Court of United States. Decree for defendant, affirmed.*

New Claims Formulated by Assignee:—Appellant Foltz made application for a patent on certain improvements in furnaces. He sold to appellee corporation his "entire interest for United States in and to improvements described in my application for United States patents as follows," enumerating this application among others. Some time prior to the assignment the patent office rejected, on the prior art, all of the claims made. After the assignment, but without further affidavit by Foltz or knowledge on his part, the assignee caused new claims to be filed, which eventuated in the issue of a patent with ten claims as therein set forth.

Subsequently Foltz organized appellant corporation, of which he was president, treasurer, general manager, and controlling stockholder, and they began to manufacture furnaces which infringed certain claims of the patent. Appellee filed its bill against appellants for injunction and accounting. On the hearing appellants offered testimony to show that Foltz was not the inventor of the thing described in the patent, and offered in evidence copies of prior art patents.

The decree of the District Court is affirmed, holding herein that the assignor of an application for a patent is estopped, as against the assignee for questioning the validity of a patent, application for which subsequently eventuates in a patent, as to claims within the scope of the original disclosure, though not made in the application as filed.

Where one, who was no novice in the patent business, assigned an application for a patent, no fine line will be drawn in his favor, as against the assignee, between claims as allowed and those originally made upon the description and drawings.—*Foltz Smokeless Furnace Co. v. Eureka Smokeless Furnace Co., U. S. C. C. A. of Ill.*

What a Claim Covers:—The issue herein involves a patent relating to improvements in working grain elevators as distinguished from storage elevators. Some years ago, builders of working elevators became anxious to construct grain bins for working elevators of reinforced concrete, but in the then state of the art heavy walls and girders were indispensable to sustain bins of such material over a working house, and were so expensive that they practically prohibited the use of concrete or masonry bins in elevators of this type. In order to make use of such bins practical, it was necessary to overcome the cumbersomeness and expense.

McQueen discovered combinations of old elements that were workable, and embodied them in a practical structure by means of which the cost of such practical working elevators was reduced about twenty per cent. Working elevators reinforced with concrete bins according to patent speedily came into common use, so that when the defendant came to construct the infringing elevator, it selected and built its elevator on the principle of the McQueen's combination.—*Appeal from a District Court to the U. S. C. C. A. of Minn. Suit in equity by the Barnett & Record Co. against the M. S. P. & S. S. M. Ry. Co. Decree for complainant and defendant's appeal. Affirmed.*

When a patentee has plainly described and claimed his improvements or combinations, he has the right to every use to which they can be applied, and to every way in which they can be utilized, whether or not he was aware of them when he secured his patent. It is one of the fundamental rules for the interpretation of contracts and grants, especially applicable to grants of patents, that in case of doubt or ambiguity that construction should be preferred which sustains and vitalizes, rather than that which strikes down and paralyzes.

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